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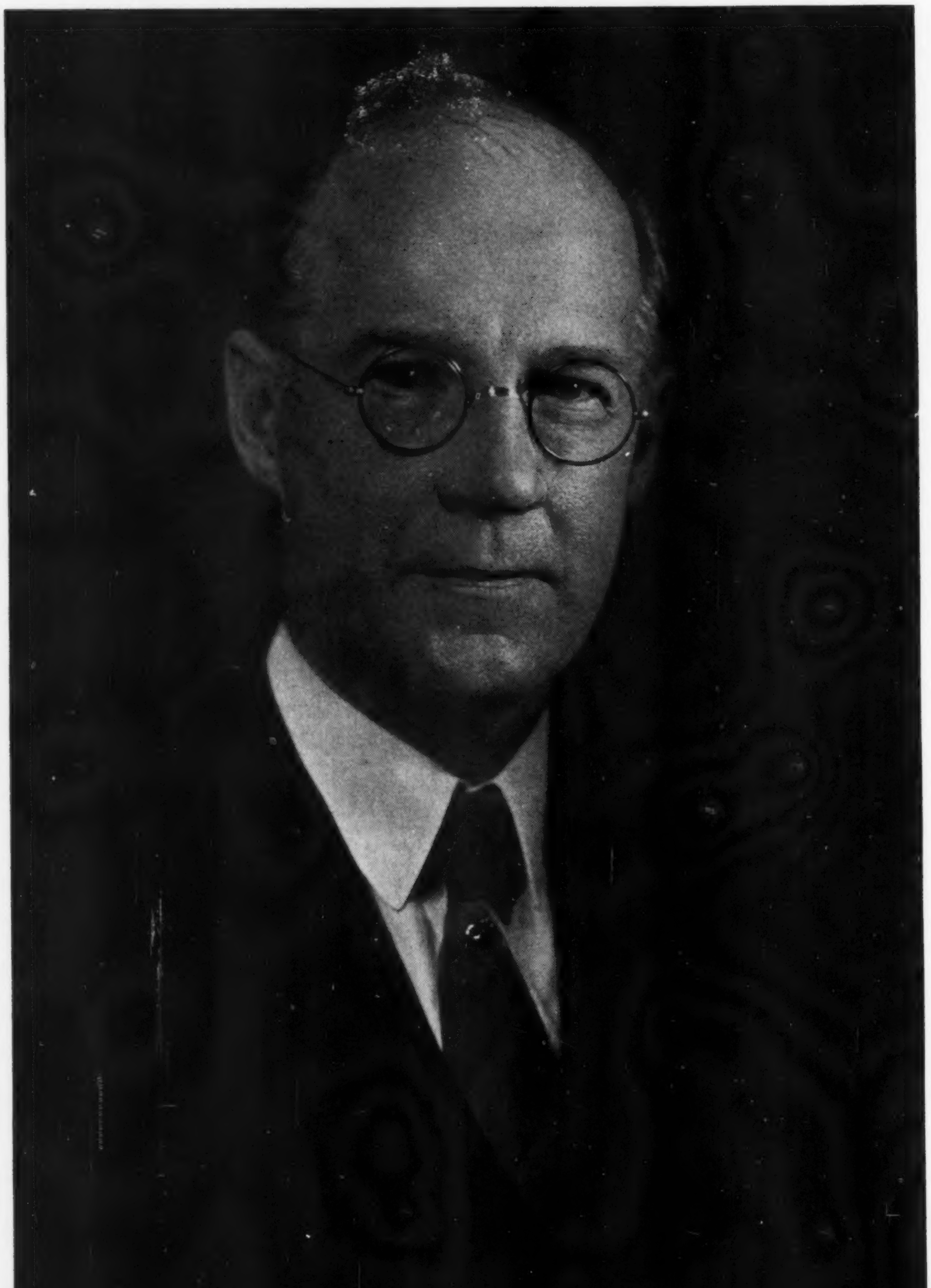

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Alexander Graham Christie

(President, The American Society of Mechanical Engineers, 1939)

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MECHANICAL ENGINEERING

January
1939

GEORGE A. STETSON, *Editor*

More Work for Engineers

[In spite of the many demands upon him during the 1938 Annual Meeting of The American Society of Mechanical Engineers, A. G. Christie, president of the Society, found time to prepare a public statement in which he set forth some of the opportunities that lie before engineers in the immediate future. In making a statement of this nature Professor Christie followed the example of the Society's first president, Robert Henry Thurston, who devoted portions of his early addresses to prospects for the future. It is a privilege to introduce President Christie to members of the Society and to readers of Mechanical Engineering by publishing his statement as the initial editorial for 1939.—The Editor.]

BUSINESS is slowly but steadily improving. The coming year should show further gains, provided no war breaks out in Europe and provided no further governmental controls or taxes are imposed. This means more work for mechanical engineers, and this work may be still further increased if these engineers are encouraged to proceed with new developments. Such developments do not necessarily signify entirely new industries. They may, on the contrary, consist of new products to be made in our present plants, new services to the public, and greater comforts available to all our population.

The present movement in our utilities to add to plant equipment will call for many turbine generators and boilers of large capacity. The trend is distinctly toward the use of higher pressures and temperatures. At present 1500 lb per sq in. is favored, though one plant for 2500 lb per sq in. is under construction. Steam temperatures of 900 to 950 F are in use. This is the present upper limit, and is likely to remain so until our research men have produced alloy steels for still higher temperatures. Steels will glow in the dark if present temperatures are increased further. Another new feature of many of these plants is the use of hydrogen cooling of the generators. This is now well-developed and results in substantial increase in capacity from generators of a given size.

The steam generators of these new plants bear little resemblance to boilers of former years. In the large barn-like furnaces of today powdered coal is burned and gives up radiant heat to the surrounding tubes which form the walls in which steam is generated.

There are many industries in which improvements and reconstruction have been delayed pending business improvement. These industries should now feel justified to proceed, and the carrying forward of this work will stimulate industry in many lines.

Certain developments, such as those in oil and Diesel engines, are proceeding to the point where these units will have even greater application in transportation and in small power developments than they have today.

Much less has been said lately concerning technological unemployment brought about by the development of labor-saving devices. What is now needed is the encouragement of new ideas and their industrial applications. Thus, as in the past, technology will provide the means of creating new jobs.

Engineers should give thought to the needs of our people for better materials for the coming increase in home building, such as new insulating and wall-forming materials, new fireproof flooring, trim, and doors, less costly air-conditioning plant, improved garbage- and waste-disposal machinery, and other equipment to lessen the drudgery and labor of housework.

New materials for industry are needed. Studies in this direction should be stimulated by such developments as the recent production of beryllium-copper alloys. Small quantities of the light metal, beryllium, added to the soft metal, copper, produce an alloy almost as strong as steel and one, in fact, that can be heat-treated to cut steel. What other alloys of equally remarkable properties still remain to be found? The answer to this question lies with engineers.

New processes and plants for the production of rayon, cement, rock wool, and pulp products are in contemplation, and these will give employment to mechanical designers and to management executives. They will also provide jobs for the unemployed.

Our increasing labor costs and taxes make efficiency in production mandatory if low selling prices are to be maintained. Here is plenty of work for production engineers. New labor relations require the services of personnel executives who are thoroughly familiar with each industry.

All of these trends and developments point toward more work for the engineer. But of still greater importance is the return to the pioneer spirit and the development of new ideas. Such creative engineering is our best hope for the return of that industrial supremacy which made America for many years the world leader in the development of new machines, new services, and new comforts and of men of the first rank in mechanical engineering.

A. G. Christie.

Paul Doty

PAUL DOTY was a familiar and beloved figure at annual meetings of The American Society of Mechanical Engineers, and his sudden death, on December 3, in his seventieth year, cast its shadows over the 1938 meeting.

Colonel Doty's association with the Society extended over nearly half a century. His graduation from Stevens Institute of Technology, in 1888, and his early association in professional work with Alexander Crombie Humphreys, a former president of the Society, provided the background and the inspiration that gave the Society so large a place in Colonel Doty's affections and interests.

Colonel Doty's professional career was largely tied up with the gas industry in the United States. Entering it as a young man fresh from Stevens Institute, he quickly rose to positions of managerial and financial importance in it, and, after service in many cities, he went to St. Paul, in 1904, where he lived until his death. Here his influence was felt, not only in the commercial and financial enterprises with which he was connected, but in the life of the community as well.

During this period Colonel Doty was associated in positions of responsibility with the Consolidated Gas Co., New Jersey, the reorganization of the Buffalo Gas Companies, the Grand Rapids Gas Light Co., the National City Bank of Grand Rapids, the Detroit City Gas Co., the Detroit Suburban Gas Co., the Michigan Gas Association, the Wyandotte Gas and Fuel Co., the Denver Gas and Electric Co., the St. Paul Gas Light Co., the Edison Electric Light and Power Co., the St. Croix Paper Co., the South St. Paul Gas and Electric Co., the Union Light, Heat and Power Co., of Fargo, N. D., and the McMillin Gas and Electric Companies Association.

With the World War came opportunity for Colonel Doty to extend his services to include the nation at large, first as major in the Corps of Engineers, then as officer in charge of utilities, Washington, D. C., and as a member of the General Staff Corps, U.S.A., to advise and make recommendations to the Secretary of War on construction projects for the U.S. Army. In 1919 he was commissioned a lieutenant-colonel, Corps of Engineers, U.S.A., and later as a lieutenant-colonel of the Reserve Corps, U.S. Army. In his adopted state, he served as brigadier-general, General Staff Corps, Minnesota National Guard.

As he had served his country during the World War, so again he served it in the war against the depression, when, in 1934, he reentered government service with the Home Owners Loan Corporation as regional reconditioning supervisor for the states of North Carolina, South Carolina, Georgia, Florida, and Alabama. Wherever a public need demanded, in city, state, or nation, in local or national engineering organization, Colonel Doty gave his services.

Colonel Doty's long experience in financial and administrative matters and his civic services with the Business League of St. Paul, and the St. Paul Chamber of Commerce, brought him into prominence in that city. As vice-president and managing director of the St. Paul Trust and Savings Bank, and as advisory engineer to a number of St. Paul financial institutions, he acquired that further experience and skill that proved to be such valuable assets to his country and to The American Society of Mechanical Engineers in the dark days of the great depression, for he had become known as an engineer-financier.

Conditions confronting The American Society of Mechanical Engineers immediately prior to Colonel Doty's administration in 1933–1934 were indeed disheartening. Expenses had been outrunning income, in spite of vigorous attempts to control the situation. Investments failed to yield their normal returns and in some cases became practically worthless. Distressing unemployment greatly reduced the membership roll and decreased expected income from dues. Everyone was in a discouraged and critical frame of mind. Budgets would not balance. Activities, gaged to the brisk pace of prosperous days, could not be curtailed as rapidly as income diminished. The opportunity which every Society president longs to grasp of increasing Society services failed. Upon Colonel Doty fell the burden of lightening sail and heaving to in the face of an economic hurricane. He met the challenge of the times realistically, and impressed upon the officers and the Council the wisdom and necessity of adhering to sound and conservative financial policies in their management of Society affairs. He continually emphasized the importance of administering the Society's financial concerns with the same acumen that would be exercised by any well-managed commercial enterprise.

It was through his work with engineers in the field, as it were, that Colonel Doty gained his broad understanding of what the average member wanted from his Society. His interest had been keenly stimulated through his long contact with the affairs of local sections during the period of his service on the Committee on Local Sections and the Council, and through his work in the advancement of engineering registration in the Society and in the State of Minnesota where he was the first registered engineer. Since its organization in 1921, he served continuously as chairman of the Minnesota State Board of Registration; in 1927 he was made president of the National Council of State Boards of Engineering Examiners, thus widely extending his influence.

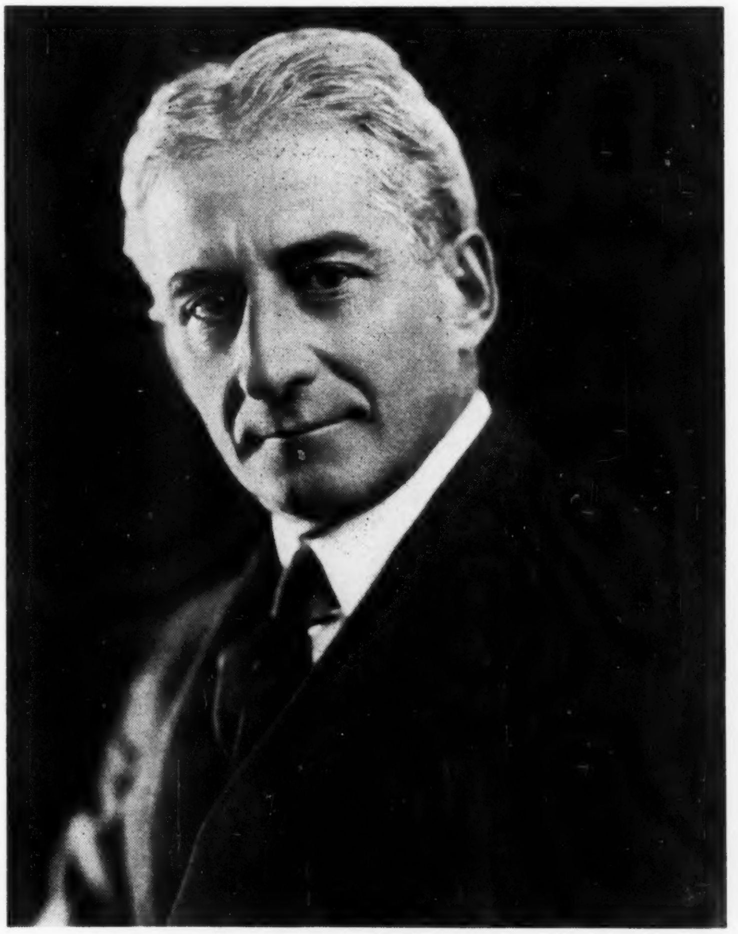
Of the warmth and sincerity of Colonel Doty's feelings, his friends had frequent evidence. Called upon in emergencies to express his views on subjects that lay close to his heart, he spoke with a simple and passionate eloquence that can never be found in prepared speeches and addresses. He was outspoken in his views on matters coming before the Council for debate and sometimes spoke for a minority opinion, but once a course of action had been acted upon, he pursued it with a staunch loyalty that was often effective in winning minorities to a majority view. Members of the Society who never or infrequently had an opportunity to come into close contact with its officers and its official discussions had in Colonel Doty an able representative of their interests. They trusted him and relied upon his judgment, and to this trust the exercise of his judgment was never false.

Mechanical Engineering: MATERIALS, METHODS, *and* MEN

By GERARD SWOPE

PRESIDENT, GENERAL ELECTRIC COMPANY

IN RESPONDING to the invitation of your committee to give the Henry Robinson Towne Lecture for 1938, I asked for what purpose these lectures were founded, and also, to refresh my memory, I reviewed the accomplishments of Mr. Towne during his lifetime. I was informed that these lectures were "established in 1925 for the presentation at the Annual Meeting of the newest thought on topics in the zone between engineering and economics; to perpetuate the memory of Mr. Towne, the outstanding feature of whose career lay in his extension of the scope of the work of the engineer to include economics, and the essential union of production and management."



Gerard Swope

Mr. Towne was always interested in the association of ideas relating to engineering and economics. It was partly because of this that he was not only a forerunner but also a great admirer of Frederick W. Taylor and his work on scientific management. My work as an electrical engineer began during the period that scientific-management ideas were being introduced. Before that time, production had depended upon the native ability of the manager of a plant, and management was either good, bad, or haphazard, depending upon the ability of the particular individual. Methods had not been studied and tested; scientific management had not been introduced or established, nor had there been any interchange or passing on the good results obtained from such experiments as had been made. Under the leadership of Mr. Taylor, an increased field of operations was presented and many entered it with enthusiasm and the belief that it would cure all the ills to which manufacturing had fallen heir. Although this was not a cure-all, it did do much toward the stimulation of thoughtful consideration of the physical problems incident to the working out of better methods. It led to an intensive study of planned factory production, an orderly progress of work and material through the factory, the best machine tools and methods for each particular operation, the introduction of high-speed tools and higher cutting speeds, the specifications under which material used in the shop should be purchased, testing materials when received, which led to their improvement, how and when the material should be delivered to the bench, etc. Study and examination of materials has gone forward steadily in technical schools and laboratories; elastic limits for materials have been definitely determined, on which new designs have been based. Polarized light, X rays, and microscopical methods have been used to ascertain the character of material, the stresses and strains to which the materials were exposed, and the effect of such exposure upon the product if new materials were incorporated.

All of this work on materials, machine tools, planning, and methods of production was, of course, essentially for the mechanical engineer to develop. It was dealing with facts and figures and the analysis and interpretation of the questions that lay behind effects and defects. The design of apparatus and machinery with this knowledge led to more economical and better design, with closer tolerances and lower factors of safety, which, with this improved and more expert knowledge, were still quite adequate. Great strides were made and this was a great era for improved methods of production in American in-

The Eleventh Henry Robinson Towne Lecture. Delivered at the Annual Meeting, New York, N. Y., Dec. 5–9, 1938, of The American Society of Mechanical Engineers.

dustry. For this stimulus of new approach and better methods we owe a great debt to Henry Robinson Towne and Frederick W. Taylor.

HUMAN ELEMENT TOO OFTEN OVERLOOKED

As I look back upon it now, I remember quite clearly the emphasis that was placed upon these two factors—materials and methods. Important as they are, there is another element even more important that the engineer must recognize, and that is men. In the enthusiasm for improving materials and methods, the human element was too often overlooked. Long before scientific management was introduced, indeed almost from the very beginning of the factory system, more thought was given to almost every other element than to the human one. With the introduction of power and machinery and access to wider markets, competition increased. Working conditions in the factories became worse; working hours were lengthened, women and children were employed, earnings of labor decreased; and, naturally enough, the workman thought the machine was his enemy, because of the way it was used. He therefore opposed its introduction and use. These conditions led to the organization of workingmen. Little time or thought was given to really understand the problem, and factory owners and labor unions fought each other by lockouts and strikes. This development—the use of force rather than analysis and understanding—has had its counterpart in other fields of human development.

The development of the factory system tended, naturally and inevitably, to the specialization of operations, to the lessening of need for skill in particular operations, and more and more the skilled mechanic became either the toolmaker or the operator of batteries of machines, which were more or less largely automatic in character, and when not fully automatic the work was largely repetitive, with only the skill that came from repetition and speed.

Then later, with the introduction of scientific management—sometimes, from the standpoint of the workingman, called the "speed-up" or "stretch-out"—the men distrusted the introduction of the engineer into a shop, because again they feared that better planning, better management, better machine tools, and better methods meant more of what we now call "technological unemployment."

Unfortunately, too often little thought and attention were given by either the management or the engineer to the resulting problem of the workingman. The engineer could and can interpret these factors—that with better materials, better machine tools, and better methods of production, costs can be lowered, with a shorter work week and higher earnings for the workman. Indeed, it is largely because of the work the engineer has done on planning in the shop, and especially in connection with mass production, that industry in America was able before, during, and after the N.R.A. days to materially shorten the work week, with increased wages; and now, again, to accept the minimum wage and maximum hours that are being imposed by law, without the disruption of industry, such as has occurred in other places where similar laws were put into effect. As a matter of fact, not only has industry not been disrupted but notwithstanding these changes in wages and hours, by the introduction of better machine tools and better methods, costs have been decreased. With these lower costs have come lower selling prices, with a consequent reaching of many more thousands of people, who benefited from the use of these products, and in this way provided greater employment and more opportunities for workers. Technological unemployment does occur, of course, when better methods and better machine tools are introduced, but this need only be a transient phenomenon. Nevertheless it must not be overlooked, and either industry or society, since they are the beneficiaries, must help to protect the individual worker. If you look back through the history of industry, in America particularly, you will see that many more thousands of people are employed in manufacturing today than were employed years ago, with the labor content of each article reduced but a greater number of articles produced and used by many more people throughout the nation. It is now beginning to be generally recognized that the development of industry must be and will be along the lines of *more goods for more people at less cost*.

The workingman must not be left without an understanding of this development. The engineer, busy with materials and methods, has paid too little attention to the human element that is inevitable in production. Neither the engineer nor the workingman, particularly in a republic such as ours, wants to be regimented. We accord the right of suffrage to the worker in our political democracy, the opportunity to determine issues, and the responsibility of electing officials, who on their part inform the electorate as to plans and policies, and finally, give a report of their stewardship. The workers, first individually and then through their organizations, have fought to have a greater part in the determination of wages, hours, and working conditions, and should have the opportunity to understand more of the policies and results of industry, and to have accorded to them in industry something of the same respect that is given to them as citizens.

ENGINEER—LOGICAL INTERPRETER FOR LABOR

The engineer is in a particularly good position, with his training and knowledge, to interpret policies for the workingman, to go along with him not only in working out the best methods of production but also the best results in industry from a human standpoint, individually and socially. To do this, it is important, first, that the engineer recognize that this is part of his job, and second, that he give thought to whitherward the development of industry is tending. To interpret a policy to others, it must first be clear to him. Clarification for engineer and worker requires time for preparation and great patience in discussion. Indeed, if these things are not understood, the spirit of the organization may be antagonistic and may result in strife, with interruption and paralysis. Time must then be taken to understand the reasons for the interruption and remove them, and even after a settlement has been reached the incident is long remembered, because of the bitterness that has been engendered. It has been found that generally the settlement of a strike—as after a war between nations—must be reached around the conference table. Is it not much better, if possible, to have the conference and understanding around the table come first rather than last? A conclusion arrived at in this way results in better feeling on both sides, of greater mutual respect and understanding, and a greater and more wholehearted desire to achieve a constructive end.

We have had an exhibition of this recently in our own country, when the railroads were confronted with their very difficult economic problem and sought to reduce wages. This was opposed by the workers and a strike was voted if the reduction in wages was put into effect. A fact-finding board was appointed by the President, which submitted its recommendation that a reduction in wages should not be made. This recommendation of the fact-finding committee was not binding on either the management or the workers, but the very fact that this impartial board had looked into the subject carefully, had come to a unanimous conclusion and had made its findings public, so that public opinion was thoroughly and accurately informed, made its acceptance on both sides a certainty. The result of this voluntary acceptance, without strife, has been that management and men are now working together to find a constructive

solution for the undeniably difficult situation in which our railroad transportation system finds itself. It is the method, with voluntary acceptance, that I am commending—not compulsory, but factual and objective presentation, with both sides and the public having all the facts before there is strife.

VOLUNTARY NEGOTIATIONS ESSENTIAL

If management—the engineer—and labor find and interpret the facts of industry and come to peaceful conclusions as to the correct solution, there will be less occasion for laws compelling compliance, with the attendant evils of lack of cooperation and of rigidity. The report of the President's Commission on Industrial Relations in Great Britain and Sweden brings out clearly and emphatically that the most important fundamental that both sides, management and labor, emphasize, is voluntary negotiation and decision, not compulsion by law or by arbitration. Indeed, in Great Britain contracts between industry and labor are not legally binding; they are, however, generally observed, but rest on a moral basis only. Strikes in these countries still occur but they are not accompanied by violence. Each side respects the other and no bad feelings are aroused which require time to heal.

Attention to working conditions has sometimes been too cursory. Often the good effects of high pay and few hours per day or week are lost because of other grievances and the hardships under which the work is performed. Analysis and study have often shown other ways of doing the work avoiding the hardships and removing the grievances. Prompt attention to grievances is essential; otherwise a comparatively minor grievance may assume the proportions of a major issue. The psychological effect of prompt attention to any grievance or question as it arises is of the first importance. Studies of rates of pay, for similar and comparable work in the community, often forestall complaints or issues, with satisfaction to both management and worker.

Great advances have been made technologically in this country—indeed, greater than in any other country. This is reflected not only in the wider distribution of a higher material standard of living but also in the fact that the workman in this country has to work less time than in any country in the civilized world for what is considered the basic elements of life—food, clothing, and shelter. This has been largely because of the fine work of the engineer. Progress in labor relations has not advanced to the same extent, nor in an unbroken line across the front of industry. There has been no unanimity in management of industry, no meeting of minds even in any one industry, except in a few instances. Partly as a result, labor has gone ahead independently, favoring mandatory legislation. Industry and labor have paid the price in less cooperative and constructive effort, greater rigidity, legal compulsion, and long-drawn-out legalistic combats.

A beginning in social-security legislation has been made, but this work has not reached a finality, either in scope or method. Much remains still to be done. Greater understanding of objectives and better methods for accomplishing the desired results still lie ahead of us. In some fields we have not even made a beginning in this quest for greater social security. Much emphasis has been and is being placed on peaceful settlement of industrial disputes. Lost time because of strikes, of importance alike to industry and men—which, by the way, in the ten years from 1927 to 1936, inclusive, was almost three times as great per workingman in the United States as in Great Britain—is still much less in both countries than the time lost due to sickness or unemployment. Why then do we place so much emphasis on loss of time due to strikes? It is because they are more dramatic, a number of people being affected at the same time, and because often, and especially in this country, they are accompanied by intimidation and violence, and because it is strife and leaves bitterness behind, which takes time to heal. Invalidity insurance is in force in many countries; we are considering it. Something has been done in other countries, and recently in our own, to ameliorate the tragic effects of unemployment, to the individual, the family, and the community, but much still remains to be done. Management—through the engineer—has a great opportunity to stabilize and regularize employment, and to assure the worker of a minimum annual wage.

MANY OPPORTUNITIES FOR ENGINEERS

Here are many opportunities where men with a broad engineering training and experience in factories can do much to improve the morale in industrial organizations. In addition to the study of materials and methods, they should know the history of the industrial revolution and the organization of labor, and, basically, the workingman and his aspirations. The best ways of presenting problems to the men, so as to increase their interest and good will, should become a part of the engineer's function, so the understanding of the men may be appealed to and their cooperation secured. The engineer must comprehend and make clear that the final aim of industrial organization and improved methods of production is better living standards not only for the community as a whole but for the men who are devoting their lives in a particular industry.

Permit me to repeat from a recent address I made:

> These democratic processes in industry and in government, based on mutual respect and cooperation, not on control imposed from without, may be neither as rapid nor as efficient as a more highly centralized form of industry or government. Although management must stand for efficiency, this is not the only factor to be considered. Since industry is a part of democracy and a democracy is made up of human beings, the development and education of these human beings, to provide for their growth, happiness, and well-being, must be sought. This means patience and appeal to the reason and the good will of the individual. If this groundwork is well laid, then in time, efficiency, as well as the happiness and well-being of the individual, may be secured.

In this way we can come nearer to the ideal that we have endeavored to build up socially, by having not only a political democracy but also an industrial democracy.

"BATTEN DOWN THE HATCH"

(Photograph by Walter C. Woodman shown at Photographic Exhibit of 1938 A.S.M.E Annual Meeting.)

PHYSIOLOGY *for the* ENGINEER

By HOWARD W. HAGGARD

YALE UNIVERSITY

Howard W. Haggard

IT IS ALWAYS a great pleasure to talk with engineers on physiological matters and it is also, as I have found from sad experience, a dangerous procedure. The pleasure comes from the fact that we have a common ground of understanding. There are certain basic principles of physics and chemistry which, when applied to the functioning of inanimate machinery, make engineering; these same principles when applied to the activity of the living machine make physiology. In our respective fields we both deal mainly with the phenomena of energy transformation. The human body is a prime mover. But —and here is the great difference in our fields—the human body is also alive. It is at the point of this aliveness and all that it implies that the engineer and the physiologist come to the parting of the ways. We meet and go together in perfect harmony of understanding as long as we discuss only detached principles and broad conceptions. The danger comes when the engineer attempts to apply, not his engineering principles but his engineering practices, to the human body. The physiologist in his understanding of basic principles may be, and usually is, a second-rate engineer, but although he cannot define life he has learned to have the feel of it, to know its limitations, and to understand something of its manifestations.

The temptation and danger in talking to engineers on physiological matters is, for simplicity, to treat the body as inanimate—divorced from life. One continually desires to liken the digestive tract to the conveyer line, grinding mills, and digesting vats of the chemical engineer; to present the nervous system in terms of the telephone switchboard, lines, and subscriber phones; and to describe the circulation of the blood in analogy with the city water system. Such conceptions give a superficial, dangerously superficial, simile that intensifies the one failing of the engineer in dealing with the workings of the human body; it subordinates the one feature that should be continually emphasized. And that feature is the peculiarity imposed by life. In following out the mechanical analogy, physiology is reduced to easy dogmatisms that are prone to make the engineer feel that the human body can be towed into the repair shop, hoisted on a trestle, and then have the heart valves ground.

The point I shall continually stress in this talk is the complexity introduced into all problems of which man is a part by reason of the fact that the human body is alive; that it acts and reacts, not as an inanimate machine, but in a special way that is peculiar to living things.

More and more the engineer deals with the reactions of human beings. The condition of the factory in which men work is only one small part of his widened scope. He has invested the home with a multitude of appliances for the convenience and comfort of the human occupants. He has altered and controlled the physical environment in which human beings spend their time, sleep, use their senses. He has put into the hands of the men and women of a whole nation, powerful machines of transportation, useful but destructive, which for all their mechanical perfection must be adapted to control by living human beings. In doing all this the engineer has educated the public, made them machinery conscious. But this education has gone little beyond the teaching of the rules of thumb necessary to employ the machines which the engineer has designed.

All this is fine achievement. But tonight I point to one peculiar aspect of the situation. And I raise this question: Is it not possible that in designing these machines, these conveniences, these artificial environments, the engineer in suiting them to human needs has also been guided only by rules of thumb of physiology as incomplete as is the simple dogmatic knowledge with which a public, untrained in true engineering, has learned to use these machines? If the engineer is going to create environments or create situations affecting human beings, then the activities of human beings, and that is physiol-

Tenth Robert Henry Thurston Lecture, delivered at the Annual Meeting, New York, N. Y., Dec. 5-9, 1938, of The American Society of Mechanical Engineers.

ogy, become a major element in his problems. I go even farther in my bluntness and say that this is the element of his problems about which the engineer knows pathetically little; that he is dangerously inclined to dismiss this enormously complicated subject with simple and incomplete explanations; and to solve problems involving two fields when he has a broad knowledge of only one. We have here, as I see it, with the continual extension of engineering achievement, a critical situation.

Now, I do not mean to imply that the engineer in dealing with his problems neglects physiology entirely. His essential oversight, so it seems to me, is in his tendency to limit his study to the one part or one function directly and obviously affected by the environment he modifies or creates. In so doing he fails to recognize one of the most basic principles of physiology: It is the integration of all bodily functions. If I were to set down the primary physiological axiom for engineers, it would be this: The body operates only as a whole; affect in any way a single part or a single function and you affect every other part and every other function—you affect the whole.

Now what I have to say tonight is very largely in exemplification of this often neglected integration of the body. I am not attempting to give here a course in physiology, but only to make one point and illustrate that one point. There are many engineering achievements from which I might choose. I have selected two: Air conditioning and modern artificial lighting, both of which have, so far as they are used, changed the human environment.

ILLUMINATION AFFECTS MORE THAN EYE ALONE

The engineer dealing with illumination would naturally learn the physiology of the eye, he would know its action and its peculiarities. But, unless he were very exceptional, he would treat the eye as if its functions were isolated—limited to the eye and complete in the eye. In reality, the eye, or any other sense organ, is only an energy-transforming device which serves to make contact between some form of energy in the environment—in this case light—and the body as a whole. In studying illumination, my first suggestion would be to go back even beyond physiology—to go back to evolution. This field would show the fact, and the reason why, that the eye itself cannot serve as an indicator of the adequacy of illumination. The eye will continue to work under conditions that strain and damage it and interfere with health. This is a necessary quality and one that has evolved with the senses, for man in all ages has met emergencies in which vision under inadequate light was necessary to save life—temporary situations in which eyestrain was an insignificant feature. The eyes have reserves of functional capacity for emergencies, but for emergencies only.

Turning from evolution to anatomy and physiology the student would find that the eyes are essentially extensions of the brain brought to the surface in order that they may be in a position exposed to light. The eyes have extensive nervous connections with the organs of equilibrium of the inner ear, the semicircular canals; both have connections with the cerebrum, the bulging upper part of the brain in which consciousness, reasoning, temperament, and similar functions are centered; the cerebrum in turn has connections with every organ in the body. But the eye and the semicircular canals have an especially close connection with the great vagus nerves. These nerves are the ones which extending from the brain down the neck and into the thorax and abdomen, exercise a controlling influence over digestion, respiration, and circulation.

The fact that vision, equilibrium, digestion, circulation, respiration, and even temperament are closely linked together is illustrated most graphically by seasickness. In this illness the primary disturbance is in the semicircular canals; but because of the close connection of these organs with the cerebrum the effect of their disturbance is influenced profoundly by mental impressions. If you doubt this, discuss food with a man who is on the verge of seasickness. The disturbed state of the semicircular canals radiates throughout all the extensive connections in the nervous system which I have mentioned. As a result, the motion of the eyes is altered, the functions of the stomach affected, and perceptions of the cerebrum influenced with the development of a despondency that engenders hope of a quick demise. Nor do the effects stop with the organs I have listed; the nervous disturbance radiates further; blood pressure is altered, so also is the flow of saliva; the muscles become weak and breathing shallow. All these far-reaching changes result simply from a disturbance in one sense organ.

Essentially the same sequence of events, though milder in their effects, occurs in car sickness, but here the original disturbance is in the eyes. It makes no difference where in the system the source of disturbance is, the results are the same. Seasickness and car sickness are acute conditions, extreme effects; but eyestrain can cause in minor degree the same changes and through the same nervous connections. From the strain put upon them the eyes may not hurt or even become red; instead, there may be dizziness because of the connection with the semicircular canals; there may be digestive disturbances because of the connection with the vagus nerves; there may be, and there usually are, altered disposition and headache because of the connection with the cerebrum.

Severe disturbances such as seasickness demand and obtain attention, they usurp all of the man's capacities. Slight disturbances, if they are persistent, may on a lesser scale usurp capacities but they are not so demanding of recognition; they may even be accepted as part of the inescapable lot of man who is resigned to minor disturbances of well-being. Nevertheless, the fact remains that for want of a few foot candles of artificial illumination or a proper arrangement of light sources, a fair proportion of men and women suffer from physiological disturbances which interfere with their capacities to work, with their digestions, and their dispositions, and hence with their relations with all others with whom they come in contact.

I do not mean here to imply that proper illumination will remedy all the ills of the body and of society. I use eyestrain merely as an illustration of the integration of functions—just one of many conditions in which the environments influence the behavior of men in directions seemingly remote from the source of the disturbance.

PHYSIOLOGY AND AIR CONDITIONING

And now in somewhat more detail I turn to another field to illustrate the same point—and the same responsibility for the engineer who changes or creates environment. I ask you to follow with me for a few minutes into a subject much to the front today—that of air conditioning. The state of the surrounding atmosphere is well recognized as one of the working and living conditions of primary importance to the well-being of men.

First in this problem I block out familiar boundaries. It is now thoroughly recognized that "bad air" so-called, with its depressing effects on bodily activity, does not acquire its badness from any change in chemical composition. The body has a toleration to variations in oxygen and carbon-dioxide content far beyond any that would occur under conditions of the most extreme bad ventilation. People live in comfort and perform their activities efficiently in Denver, Colorado, where the normal partial pressure of oxygen corresponds to 16 per cent of oxygen at sea level—nearly 5 per cent below that in this room. Carbon dioxide is no longer considered a poisonous

waste; there is nearly 6 per cent of this gas at all times in the air of the lungs. The old conception of a poisonous effluvia given off from the lungs and from the human skin has now been relegated wholly to the field of cosmetics and finds its place in the commercial exploitation of mouth washes and deodorizing soaps. In short, we all accept the statement that the effects of poorly conditioned air are not respiratory but cutaneous. Bad ventilation acts upon the temperature-regulating system of the body.

PRINCIPLE OF VITAL CONSTANTS

The temperature-regulating system brings us at once to a broad principle of physiology; it is the principle of vital constants. We speak of the conditions in the interior of the body as the internal environment. This internal environment is, during health, kept in a state of amazing uniformity. The range of conditions which the living and active cells of the body can tolerate is extremely narrow. A slight change in alkalinity, in salt concentration, in chemical composition, or temperature, may have a profound influence upon cellular activity, may even stop it and so end the phenomena called life. To maintain this uniformity of internal environment the body has elaborate regulating mechanisms.

Next, the body has about it an external environment—a highly variable external environment to which the body must make continual adjustments through its regulating mechanisms in order to maintain the indispensable constancy of internal environment. In making these adjustments the body expends from its capabilities. I do not want to say here that it expends its energies because, particularly in speaking before an engineering group, I deplore the loose use of the word energy such as we find in explanations of this sort or in its use in such absurd expressions as "nervous energy." I prefer the somewhat vague and certainly awkward expression, expend from or limit its capabilities. To exemplify what I mean and at the same time to anticipate what I shall talk about, there is this situation: In very hot and moist surroundings bodily functions are so engaged in maintaining a uniform body temperature that these functions have little capability left for other performances. Regulation is not carried out by some simple mechanism; it comprises all bodily functions and involves their activities. It does not take a physiologist to tell an engineer that hot surroundings make the performance of a task difficult or impossible.

Body temperature is one of the vital constants, but this does not mean a uniformity with the precision of engineering measurements. The temperature in the mouth is on the average 98.6 F at 3 p.m., but it is nearer to 97 F at 3 a.m.—a 2-deg daily variation; it is one or two degrees higher in the interior of the body than in the mouth and at times many degrees lower in the flesh of the feet and hands; the temperature of the exposed skin may be only slightly above the surrounding air. I deal with this elementary physiology with which you are familiar because I want my story continuous.

The heat to keep the body warm is developed in the active tissues, mainly the muscles, and, as you know, a muscle always during life, even in rest, is slightly tense; this tenseness necessitates the liberation of energy as heat. The amount of heat produced in a man relaxed and warm in bed is regulated by another system, which I shall not discuss, to a constant minimum basic evolution of some 160 Btu per hour per square yard of skin surface. A man of average size has about two yards of skin. From this low level, heat production may rise during muscular exercise to 20, 30, even 40 times the resting rate. Here then is the body with a widely variable heat production and widely variable external environment into which this heat must be eliminated; the body must adjust between the two and maintain a reasonably constant internal temperature.

Some 80 per cent of the heat dissipated from the body goes out through the skin but most of it is not directly conducted to the surface from the underlying tissues. The heat is brought to the skin by the blood. The amount of blood flowing through the skin determines the temperature of the skin and hence the heat loss. The size of the blood vessels in the skin is controlled by the nervous system; there are impulses which cause the muscles in the walls of the vessels to relax and so permit enlargement; other impulses constrict and so lessen the size of the vessels. These impulses in turn flow out from a heat-regulating center in the brain—an engineer would call it a thermostat, and, I suspect, begin to make analogies. The secretion of sweat is similarly under nervous control. When the temperature of the blood rises a fraction of a degree the vessels in the skin increase in size and more sweat is secreted. When it falls, the vessels constrict and sweating is diminished. All this is simple and straightforward.

A COMPLICATING FACTOR IN COORDINATION

But now we come to the first complicating factor in the coordination of bodily functions. When the vessels of the skin expand, the resistance to the flow of blood is diminished, since by dilatation of the vessels in the skin the channel for the flow of the fluid is increased. The pressure, therefore, tends to fall and it in turn must be regulated, for here, within limits is another vital constant. To hold up the pressure, arteries are constricted in parts of the body other than the skin, a compensatory constriction mainly in the digestive organs. Consequently digestion may be slowed; in extreme cases it is stopped. To help hold up the pressure of the blood diverted to the enormous channels in the skin, the heart must pump a greater volume for the circulation. In hot surroundings the heart in a man at rest may be doing as much work as it would in the same man performing violent exertion in cool surroundings. You have noticed the deaths, during the heat waves, of invalids with damaged hearts. Heat to them is the same as the exertion which they are incapable of making. It correspondingly limits the capabilities of the man with the normal heart.

All this arrangement for losing heat that I have described is known in my field as the physical regulation of body temperature. There is a second controlling mechanism; this one is not physical but chemical. It adapts man not to heat but to cold. In cold surroundings even when the heat losses are brought to the lowest possible amounts, when the vessels of the skin are shut down to the utmost and the secretion of sweat is at a minimum, the heat produced in the body at rest may not be sufficient to maintain the normal temperature. The skin becomes uncomfortably cold. The temperature we feel is never that of the interior of the body but only that of the skin. In the cold skin nervous impulses arise and are retransmitted from the spinal cord and brain to the muscles. The muscles grow tense, burning more food and so producing more heat; if tenseness alone fails to give the needed heat, the muscles contract and relax rapidly, the condition known as shivering. At the same time the muscles attached to each hair pull in an effort—an abortive one—to make it stand erect, thus as in other animals to expand and enmesh a greater layer of still air about the body. The best that a human being can do in this respect is to develop goose-pimples.

To emphasize the independence of internal temperature and skin temperature in sensation and regulation I digress to point to the peculiar conditions occurring at the beginning of a fever. Under the influence of bacterial products liberated in the body, the heat-regulating center in the brain closes down the blood vessels in the skin; less heat is lost but no less is produced, the

temperature of the body consequently rises and there is fever, but the man, instead of feeling warm feels cold, for his skin is cold; his muscles shiver, he has a chill. I emphasize this control of muscular tenseness by skin temperature because it is a point to which I return.

Now in all I have said, I have made a good case for air conditioning. Any air conditioning, dating back as it does to the first savage who built a fire in his cave or fanned himself with a leaf, now takes on new and vast importance at the hands of the modern engineer. I see, as the engineer sees, the great advantages of comfort and of conservation of capabilities that may be thus directed to productive work. But I see also a drawback in the refinements of air conditioning. From my brief story of temperature regulation it would seem to be evident that the more nearly the cooling powers of the external environment can be brought to the optimum for free heat loss and comfort, the less effort is needed by the regulating mechanism of temperature control in maintaining a uniform internal environment. Simple, clear, and advantageous. But here we come to the danger of simplicity. The engineer is, in matters of development, a man of great refinement; if in the room a temperature variation of 5 deg can be achieved, why not one of 2 deg, why not, with refinement of control, make it a fraction of a degree? Fine in principle, fine in selling talk, but disastrous in physiological practice. Here is where the peculiarity of living things comes into the situation.

CHANGE PROVIDES STIMULATION

The body responds only to stimulation. When stimulation is removed, stagnation results and the human machine does what the inanimate machine never does—it goes to sleep. Continual activity is the penalty for life. When a machine is stopped it does not deteriorate functionally, but the body does. Tie an arm across the chest, keep it stationary, and the muscles shrink and lose their strength. Man has never, until the engineer came on the scene, met an external environment in which the cooling powers of the air were held constant. For the man who is exercising, such constancy is not detrimental, for in him the rate of heat production is variable and the heat-controlling mechanism is kept active even when the external temperature is uniform. But let a man at rest stay in such air and his heat-controlling mechanism also comes to rest; I should like to say it goes to sleep. The invigorating pleasant sensations experienced on a brisk fall day are due to the tensing and relaxing of the muscles as the cool air strikes first one area of the skin and then another. It is a sort of continual massage.

The temperature-regulating mechanism of the body at rest operates best when there are slight but definite and continual changes in the cooling power of the air. The maintenance of too-uniform air conditions relaxes the muscles—takes away this stimulating property of irregular cooling. It relaxes too, as I have said, the temperature-regulating mechanism—makes it for a time sluggish so that it does not then respond well to the severe and abrupt changes experienced in going out of doors from the air-conditioned room. As a result of this slowed response there may be an exaggerated sense of heat; there may be changes in many functions such as blood pressure; and there may be annoying nervous disturbances. What, in this rather elaborate way, I have been trying to point out is that temperature regulation of the body is a part of the living system. Its vital peculiarities cannot be ridden over roughshod by the engineer; they must be deferred to.

I have said nothing here about the effects of air conditions on the nasal passages and I have not for the simple reason that, in spite of much talk, neither the physiologist nor the engineer as yet knows anything about them. I have not mentioned the influence of humidity, if any. The often-mentioned delightful feel of the air in greenhouses in the winter time is not due to the high humidity but to the vertical movement of the air resulting from the cold roof. Again, I have not dealt with the bracing effects of unequally applied radiant heat or the influence of air conditioning on the prevalence of infectious diseases about which again, in spite of much talk and a few inconclusive experiments, no one has any sound knowledge. But we can be sure of this: You cannot take the facts of climatology and apply them to an air-conditioned room. Because there are few head colds in Tucson, Arizona, and little scarlet fever in the tip of Florida means nothing in air conditioning, for here it is not man but another living organism that is concerned. The living organism in this case is the parasite that causes disease. It too has its limitations to external environments. It is not warm weather acting on man that keeps him free from colds and scarlet fever; or cold weather acting on him that keeps him free from yellow fever. Weather does not cause disease, except sunburn, sunstroke, heat collapse, and frostbite. Most diseases—even the common cold—are due to infections, and it is the parasite that has its climatic preferences. Until the engineer can air-condition all outdoors his efforts will have little effect on the occurrence of infectious diseases. And if and when he does condition climate he will not do away with infections but only with the seasonal variations in the kinds of diseases. Perhaps in the modern, tight, air-conditioned room where air movement is slight as compared to that in the drafty houses with their fireplaces in which our grandfathers lived, the spread of infection is actually increased.

Sometimes in my more Spartan moments I have the passing thought that the engineer may be undermining our national constitution—human constitution—by taking away the hardening influence that our pioneer ancestors knew. I have visions of my grandfather rising in the morning, breaking the ice on the water pitcher, chopping wood for the kitchen stove and fireplace, leading a vigorous, rugged life. And then when I have thoughts of our own cultivated, nurtured decadence with the body made soft and flabby at the hands of the luxuries of engineering, I admire our ancestors—but I thank God for the engineer and his automatic heating and air conditioning.

THE BODY OPERATES AS A WHOLE

And now to conclude, I want to brag for just a moment about the living human machine with which I deal. When we turn from temperatures of the air to its pollution with dust and fumes we find that the human body has anticipated the best modern principles and practices of air conditioning by some millions of years.

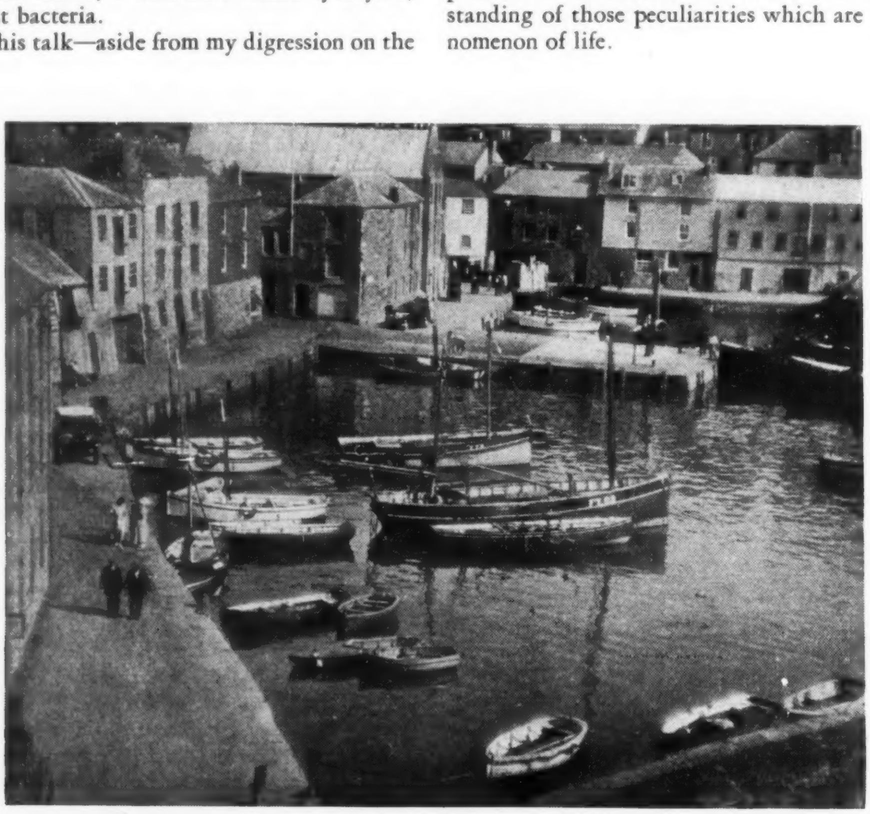
Under the conditions in which men work—indeed in the conditions in which we all live—the air breathed may, as between winter and summer, have a maximum temperature variation of more than 100 F; the humidity may vary from a few per cent of saturation to full saturation, and the air may contain chemical substances, dusts, bacteria, and fungi. The air reaches the nose in these enormously varied physical states and in all degrees of pollution. Ten inches from the nose are the lungs, exquisitely sensitive organs which are dangerously injured unless the air reaching them is so conditioned as to be of uniform temperature at 98 F, nearly fully saturated with water vapor, freed from dust, and free from fumes and bacteria. At least 500 cu ft of air a day must be thus conditioned for the lungs. The conditioning is carried out in a space 3 in. long and less than 2 wide—the nasal passage—equipped (and it has been so equipped for thousands of centuries) with all modern air-purifying devices. Those of you

who may have regarded the nose as merely an appendage of the face and the annoying seat of head colds, I ask to consider this organ in all its true glory. The nasal passages go back straight into the head, joining, in the rear, the throat. The slanting extension in front is merely a roof, a cover to keep out the rain and other projectile bodies. The real functions of the nose are carried out by the walls of the passages. They gain surface from a dividing septum and on each side there are horizontal projections called turbinates. The air entering the nose is baffled, is spread into thin layers between soft warm tissue wet with a viscous fluid. The air is heated and moistened. The dust particles and bacteria are projected against the sticky surface and are held there.

This fluid that forms a layer on the surface is called mucus; it is sweated out from the membranes of the nose but it is a very different fluid from sweat; mucus is a clear liquid of extremely high viscosity. It forms an unbroken film covering completely the surfaces of the nasal passages and extending down into the throat. Thus a protective layer is formed separating the flesh from the air. This layer continually flows backward; new fluid is formed on the surface as the layer passes into the throat to be swallowed. The movement is not from gravity but is imparted by structures called cilia. Cilia are microscopically minute hairlike structures extending from the surface of the nasal passages in millions. These cilia move; they wave back and forth slowly in one direction, rapidly in the other. They impel the mucus film continually backward; the trip from the tip of the nose to the back of the throat level with the base of the tongue takes about 12 min. Visualize, if you will, the continuous moving unbroken film of viscous fluid and you have the essential principle in the finest air-conditioning device that has ever been developed. And add to this elaborate arrangement, if you will, the presence of a secreted antiseptic in the mucus, a substance called lysozyme, that will destroy most bacteria.

Now, throughout this talk—aside from my digression on the beauties of the nose—I have tried to emphasize—and elaborate—one point. It is this: There is no isolated, no separate, no independent part of the body; the body operates only as a whole. When the engineer creates or controls environments in which the body is to operate, any change in any one feature of the environment affects the body as a whole. And furthermore, the effect on the body alters its reactions and tolerances to all preexisting conditions in the environment. Thus to be specific, air conditioning is not limited in its physiological effects to its influence upon heat-regulating mechanism of the body; instead it alters the body as a whole in every one of its physiological and psychological functions. Because of these changes, the man's reactions are changed to all sorts of situations and influences that existed before air conditioning was introduced. From one change in his environment he becomes a changed man. This is true for the reason that none of the functions of the body works alone; instead, the action of each is integrated with that of every other function; alter one function and you have influenced all. Do so seemingly insignificant a thing to a man as pull one hair on his head and you deal, not with the scalp alone, or even the head alone, but with every function in his body, with the man as a whole.

Today, the engineer goes into every field touched by man and there he creates for men new or changed environments. Each creation, each change, involves a reaction—a physiological response. Each creation and each change, since it affects all situations which have existed before, becomes, not a mere addition, but a completely new problem to be solved in its totality. In every such problem of engineering there is this physiological factor. And my hope is that the engineer will recognize this factor and give it its proper consideration. I hope then that he will learn some physiology and in so doing learn to know the human body, not in terms of engineering practice or as isolated functions, but with a broad understanding of those peculiarities which are imposed by the phenomenon of life.



"MEVAGISSEY"

(Photograph by R. R. Weddell shown at Photographic Exhibit of 1938 A.S.M.E. Annual Meeting.)

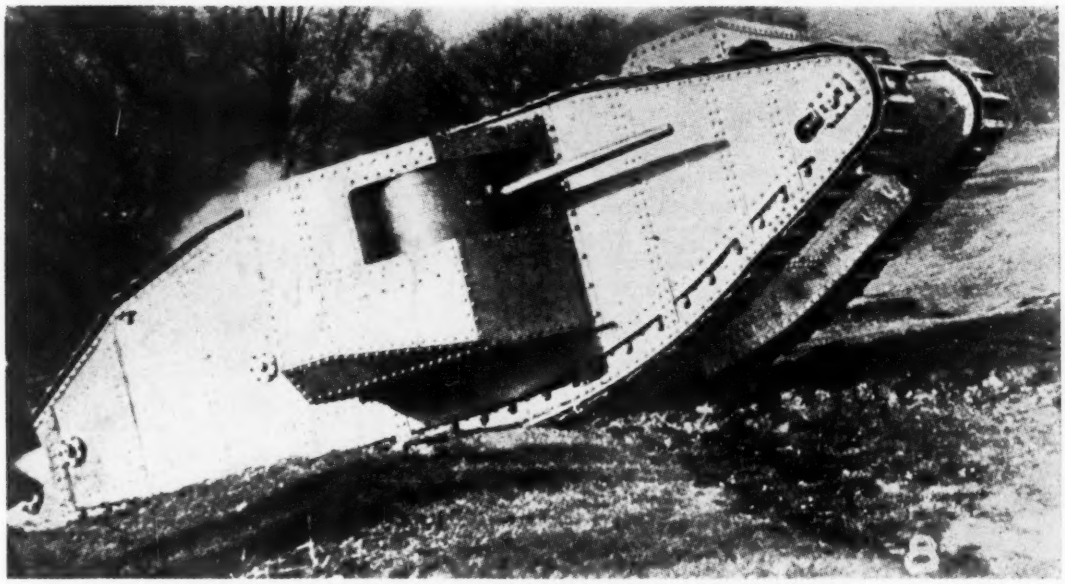


FIG. 1 THE FIRST TANK

The Manufacture of HIGH-SPEED TANKS

By JOHN K. CHRISTMAS

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THE OBJECT of this paper is to acquaint civilian engineers with the development of the fighting tanks, one of the major weapons of modern machine warfare, although the author realizes that many such engineers have contributed directly and indirectly in the development of this weapon. After reviewing briefly the history of tank development, the author will discuss its present status as a weapon and then describe its manufacture. For reasons of national policy there are many engineering details which cannot be given in such a paper as this. Furthermore, where opinions are expressed they are those of the author, and not the official views of the War Department.

The tank was first conceived by a small group of Englishmen in 1914, led by Winston Churchill, who felt that the blood burden of modern infantry could be much eased and its job done better by the use of modern machinery. While war chariots had been thought of before, only the then recently achieved practicability of the internal-combustion engine and the caterpillar tractor made the fighting tank a feasible idea. Special interest to us lies in the fact that the caterpillar tractor is primarily the development of an American, Holt. The first tank is shown in Fig. 1. Tanks were originally known as "landships," the name "tanks" being at first used only to mislead enemy intelligence agents, and were first used in battle by the British on the Somme in August, 1916. Inventors may be interested to know that the French army, led by Colonel Estienne, also originated and developed a tank, although the British efforts first bore fruit. By 1918 all armies on the Western Front were using tanks. When the Armistice was signed General Pershing had endorsed tanks to the extent that the U. S. Army had on order some 23,000 tanks of various sizes.

The purpose of the tank is to transport fire power and its fighting men with reasonable safety to the enemy's position, and to mechanize (or increase), with armor, the soldier's defense in the same manner as the firearm has long and increasingly mechanized his offensive ability. The mechanical locomotion, or mobility, provided by the tank is fundamental in order to carry the necessary armor, but this mechanical propulsion incidentally also makes possible a quantity of fire power and a maneuverability not available with infantry. However, great speed is definitely neither essential nor desirable in a tank since the rough and uncertain nature of the battlefield definitely limits the speeds which can be used. Definitely, the tank through its armor mechanically integrates into a balanced weapon the three elements of combat—fire power, mobility, and protection.

The Armistice of 1918 virtually stopped tank development as armies and nations somewhat contentedly settled back to economy. Again, mainly in England, a few defiant and fresh spirits such as Fuller and Hart, kept the idea of mechanized warfare alive by their vigorous writings. This movement was reinforced by the general feeling in all European countries that something must be done to conserve man-power in future wars. Soon all major armies began some tank development and even-

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This article expresses the personal views of the author and does not represent War Department policy on the subject.

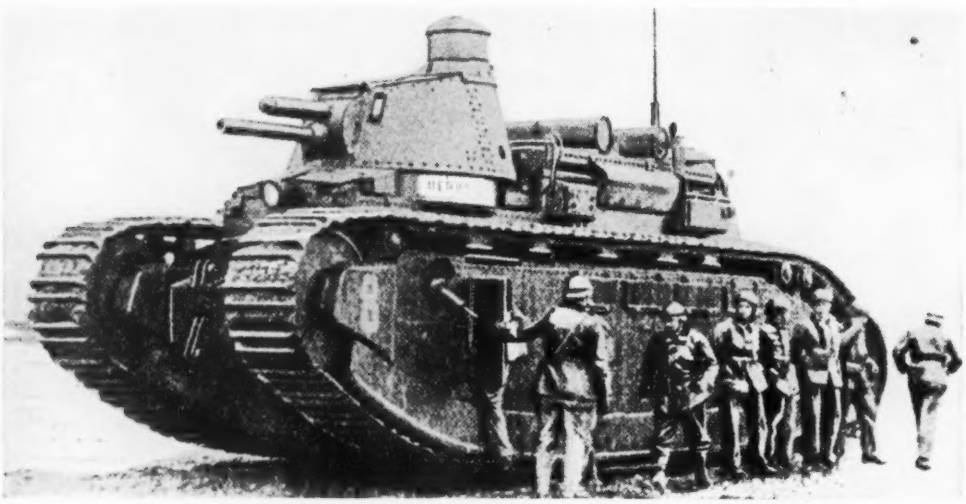

FIG. 2 A FRENCH TANK WHICH WEIGHS 74 TONS

tually hundreds of experimental vehicles, some of the most weird design, were built. As the movement gathered impetus, fostered by the small wars always going on somewhere in the world, tanks improved so much mechanically that all industrialized nations now have tanks which are capable of long and reliable operation both on the road and on the battlefield. This development was, of course, closely allied to the great improvements in the automotive as well as allied industries.

TABLE 1 ESTIMATED ARMIES AND NAVIES OF THE PRINCIPAL POWERS OF THE WORLD, OUTSIDE THE UNITED STATES (LATE 1937)

(Taken from the Command and General Staff School Quarterly, Fort Leavenworth, Kansas)

Nation	Standing army	Air force	Trained reserve	Maximum military man power	Airplanes	Tanks	Navy tonnage
British Empire..	390,291	46,600	632,053	18,000,000	4000	750	1,232,800
France.........	708,000	34,350	5,500,000	8,000,000	3000	3000	546,000
Russia..........	1,500,000	50,000	19,450,000	32,000,000	4700	3500	200,000
Germany.......	650,000	80,000	1,850,000	13,000,000	3000	2300	300,000
Italy.............	1,111,593	201,300	5,214,368	8,000,000	3200	2000	529,000
Japan..........	280,000	15,000	2,000,000	18,000,000	2000	800	754,000

Tactically, the development has been so diverse that in the world today there are tanks in service weighing from 3 to 141 tons, with speeds from 5 to 50 mph, armor from $^1/_4$ to $2^1/_4$ in. thick, crews from 1 to 28 men, and guns from 0.30 to 6 in. caliber. To illustrate this development, Fig. 2 shows a large French tank weighing 74 tons, and Fig. 3 shows briefly our own more modest tank development through 20 years. Fig. 4 shows briefly 20 years of engineering development in tanks.

At the present time all industrial nations are building tanks that are reliable mechanically, simple to operate, capable of movement under their own power with an army anywhere, well-armored, heavily armed, and reasonably durable. Both the initial and the operating costs have come down markedly. More specifically, our own tanks such as this paper deals with, can operate (and have recently) many hundreds of miles over roads and off them at speeds up to 40 mph with little mechanical trouble. In a recent maneuver, 88 such machines started and 88 returned under their own power from a 700-mile operation over roads and cross-country terrain of various conditions.

The present tactical status of the tank is, like that of the airplane, still a topic for discussion. This is necessarily so for two reasons: (1) Only recently have tanks been available in such quantity and such quality that conclusive tactical problems could be solved in field maneuvers; and (2) no large-scale war between industrial nations has occurred to give tanks a conclusive test tactically. Since certain recent popular-magazine articles are predicated or the failure (predicted by many) of small lightly armored tanks employed in small numbers in Spain, let me present more data on this subject. Table 1 lists the known tank strength of some major armies about a year ago. Today many nations are positively known to be producing additional tanks, some by quantity-production methods. The published tactical doctrine of France

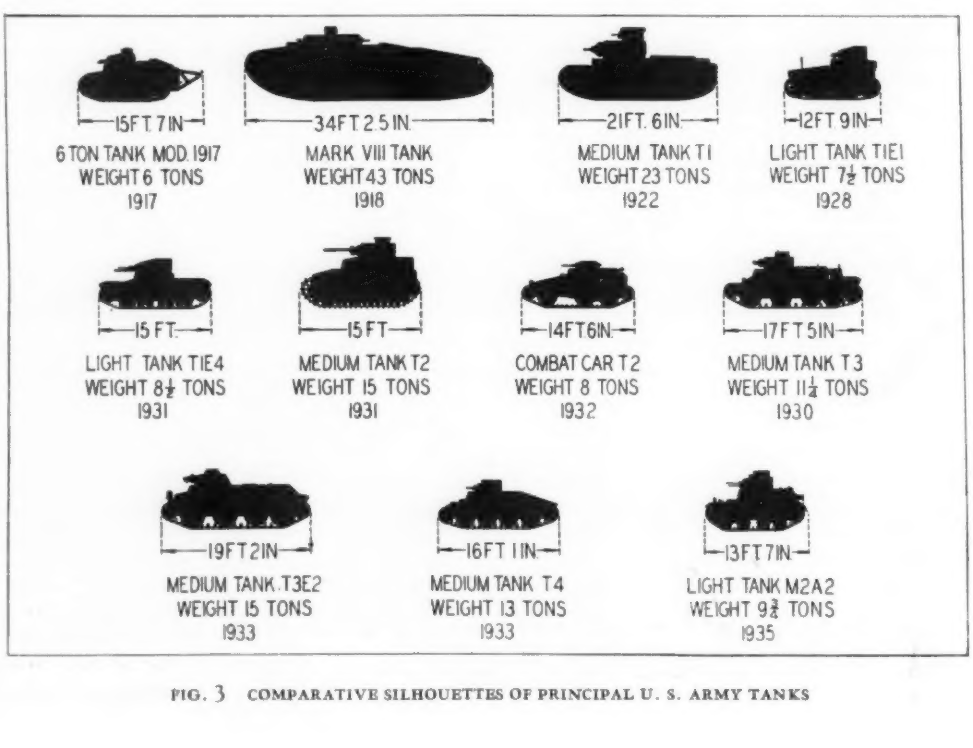

FIG. 3 COMPARATIVE SILHOUETTES OF PRINCIPAL U. S. ARMY TANKS

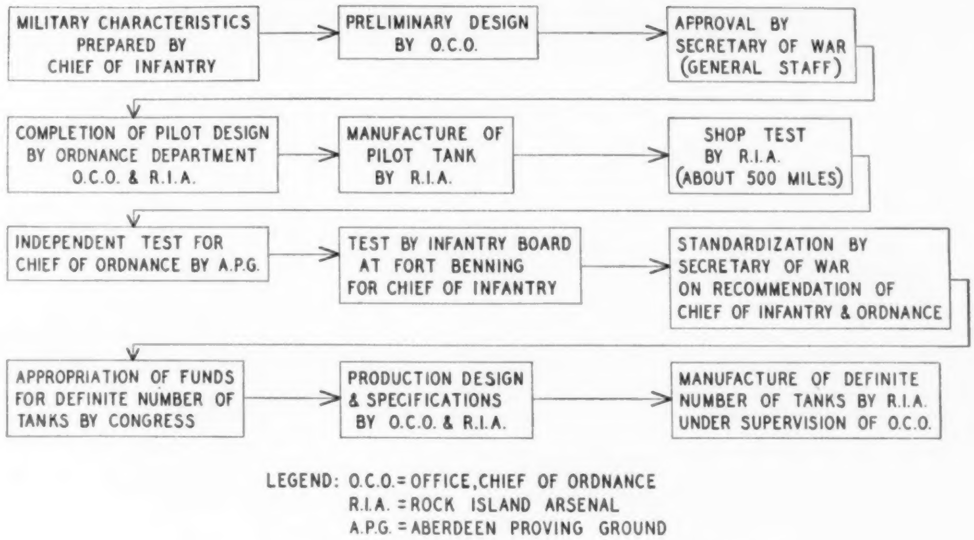

FIG. 5 MAJOR STEPS IN PRODUCING A U.S. FIGHTING TANK

is to make no major attacks without the support of tanks, used on a scale of 40 to 80 tanks per 1000 yd of front. Finally, if tanks are of no avail, why incorporate 20 to 30 special, high-powered, and expensive antitank cannon in each infantry division, as several foreign armies do? Finally, in judging the value of the tank from the current wars, we must also remember that where lives are cheap, industry backward, and the treasury low, there is but little incentive to use tanks. Even so, we know that tanks are being used to some extent in these current wars.

This brief review of tank development would be incomplete without mention of mechanization from the economic standpoint. The term "mechanization" refers to the use of automotive *fighting* vehicles, principally tanks, and not to the motorized transport of men and supplies behind the battle line. It can be conclusively shown from our own expenditures that, entirely aside from the intangible and ethical losses due to war casualties, men are, in war as in industry, the most expensive item on the ledger. A soldier must be trained, fed, housed, equipped, paid, hospitalized, and finally he or his dependents pensioned, quite justly. The initial cost of a light tank in quantity production is about equal to the grand total cost of one fighting soldier; however, as to their relative fighting powers there are still some differences of opinion. Further, when a tank or other fighting machine becomes a casualty the account is definitely closed. Finally, the point is often being raised in current military literature, that men of the western nations will reluctantly again use their bodies to do what a machine can do, just as modern man will not in peace do the drudgery he formerly did in mill and mine. Table 2 epitomizes the relative quantities of men and machines used in comparable mechanized and nonmechanized fighting units. Table 3 compares the cost of land, sea, and air mechanization. As has been recently stated, mechanization means "being stingy with blood and lavish with steel."

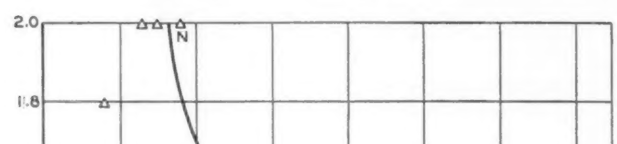

FIG. 4 TREND IN THE ENGINEERING DEVELOPMENT OF TANKS DURING THE LAST 20 YEARS

THE MANUFACTURE OF TANKS

In our Army, a new type of tank is developed by a definite procedure which is outlined in Fig. 5. You will note that this procedure definitely prevents the tank designer from indulging his individuality; he must meet the demand of the ultimate customer, the fighting man of the infantry or cavalry, both of which use tanks. Unlike the nonmilitary customer, the army does not think primarily of cost, but demands the maximum in performance and reliability. The tank as a whole has no counterpart in industry, its nearest relative being the track-type commercial tractor; but, whereas a 10-ton tractor has a 60-hp engine, goes 6 mph and carries no load, a 10-ton tank has some 250 hp, can go 40 miles per hour, and carries a load of armor, guns, ammunition, and men amounting to 35 to 50 per cent of the gross 10 tons. The other major difference between tank and tractor manufacture is that the "turnover" or annual production of tanks is, in our Army, both small and very fluctuating. From 1920 to 1935 the United States built only 31 tanks; these were all development or pilot vehicles. Since then we have made new tanks to replace the World War 6-ton and Mark VIII models used by our tank units.

Each new design of tank is based on and is partly an outgrowth of its predecessors. A tank is so complex a mechanism that the tank designer must necessarily synthesize, coordinate, and integrate the knowledge and ideas of many specialized fields including those of engines, transmissions, clutches, armor plate, rubber, machine guns, radio, commercial tractors, and automotive accessories. From these specialized fields we have

TABLE 2 COMPARISON OF LOGISTIC DATA OF TWO UNITS OF APPROXIMATELY EQUAL FIRE POWER

	Cavalry brigade	
	Mechanized	Horsed
Strength:		
Men	2346	9275
Vehicles, all kinds	771	910
Animals	....	10714
Class I supplies[a] for one day, tons	81	92[b]
Gasoline and oil for one day, tons	76	15
Mobility factor, miles travel per ton of class I supplies	1.84	0.27[c]
Length of column, miles	14.2	19.2
March per day, miles	150	25
Day of fire, tons of ammunition	140	157
Fire power per man, lb	120	34
Standard railroad trains for a movement	14	57
Ship tonnage required for overseas movement	25000	135000

[a] Food, fodder, and fuel for men, animals, and vehicles.
[b] Less 75 tons of hay.
[c] Less hay.

TABLE 3 EQUIPMENT COST PER MAN

Unit	Approx investment in equipment per man in crew
Tank	$ 6250
Pursuit plane	25000
Bombing plane	15000
Battleship	25000
Submarine	50000

obtained and are obtaining fine cooperation, both formally and informally. A major instance of this cooperation is a large and representative standing committee, now over 15 years old, of the Society of Automotive Engineers which advises the Ordnance Department on its automotive problems through formal annual meetings. In addition to the specialized fields mentioned, there are others such as high-speed tracks, suspensions, and tank steering which have no civil interest and are the special province of the ordnance engineer.

Let us now look briefly at the manufacture in limited production of a light tank which has been standardized or adopted by the War Department for use by our combat units. For this purpose the "light tank" of 10 tons gross weight, shown in Fig. 6 has been selected. This tank was designed and developed as already indicated in Fig. 5, and when the design was standardized and funds obtained from Congress a definite order for about 100 tanks was placed at Rock Island Arsenal, Ill. This tank, which weighs 10 tons, is propelled by a 270-hp gasoline engine located in the rear, which is connected, through a master clutch and propeller shaft running through the fighting compartment, to a five-speed constant-mesh mechanical transmission. This, in turn, is connected to a bevel gear and controlled differential and propels two cross shafts which, through reducing final drives, propel the two track-driving sprockets on the sides of the tank at the front. Steering is accomplished by two variable brakes applied to the controlled differential so as to cause the two cross shafts to run at various differential speeds. The tank is suspended on four sets of two-wheeled trucks, each individually carried on volute springs. The track consists of steel links to which a special rubber is vulcanized. These track shoes are assembled into an articulated continuous track by the use of rubber-bushed steel hinge pins and end connectors in such a way that no metallic friction occurs in the joints of the track. The wheels supporting the tank on the track have solid rubber tires of a special design.

Having received an order from the Office of the Chief of Ordnance to build a definite number of light tanks, the Arsenal's drafting room and engineering section must prepare over 3200 detail working drawings. These drawings show the dimensions, material, and heat-treatment of each part, except that where a standard commercial article is called for by its trade name, in which case a commercial identification number is given. From these drawings the planning room prepares the bills of material, operation route sheets and other manufacturing information for over 22,000 parts. However, in procuring the latter, or commercial type of parts, an additional step is required which is not required ordinarily in private practice, that is, the preparation of a procurement specification. This is necessary because the laws of the United States, and the decisions of the courts and the Comptroller General corollary thereto, require that except for experimental purposes all procurement of supplies and material by the Government be by competitive bidding against specifications, and that the award be made to the lowest responsible bidder complying with the specifications. The preparation of these specifications is in most cases one of the major problems in the manufacture of a tank, because it is difficult to write a specification which is not restrictive as to the eligible bidders, while at the same time insuring that the United States will obtain a satisfactory article in every respect. Particular difficulty is had in the procurement of a complex manufactured article, such as an antifriction bearing, where design, material, heat-treatment, inspection, and the experience of the contractor all contribute to the final quality or performance of the article; all of these qualities are difficult to stipulate in a nonrestrictive specification.

FIG. 6 U. S. LIGHT TANK DESIGNED IN 1934

(Weight = 19,400 lb gross; length = 13 ft 7 in.; height = 7 ft 8 in.; climbing ability = 35 deg; armor plate thicknesses = $^1/_4$, $^1/_2$, and $^5/_8$ in.; armament = one 0.50- and two 0.30-caliber machine guns; volute type of suspension; 270-hp 7-cylinder Continental radial engine; speeds = five forward and one reverse; maximum speed 45 mph; cruising radius, 100 miles; crew = four men; controlled differential steering.)

The procurement is further complicated by the absence of any simple and generally recognized acceptance test as a criterion of quality. In order not unduly to control the design details of a commercial article and thus restrict bidding, resort is usually had to a performance test and a bonded guarantee for satisfactory service for a definite time or mileage.

The principal items which are procured commercially are the engine and its accessories; all the armor plate, fabricated or machined ready for assembly; the five-speed constant-mesh-type mechanical transmission; and the rubber elements of the tank. For each of these major items an elaborate and detailed engineering specification is drawn (reinforced by necessary drawings) describing what is wanted, what it must do, how tested and accepted, and the guarantees involved. The procurement of such important items is controlled by a resident inspector at the successful-bidder's plant. This resident inspector is a civil-service employee trained at the arsenal with respect to the special article which he is inspecting, and reporting to the arsenal commander through the Ordnance Procurement District in which the manufacturer's plant is located.

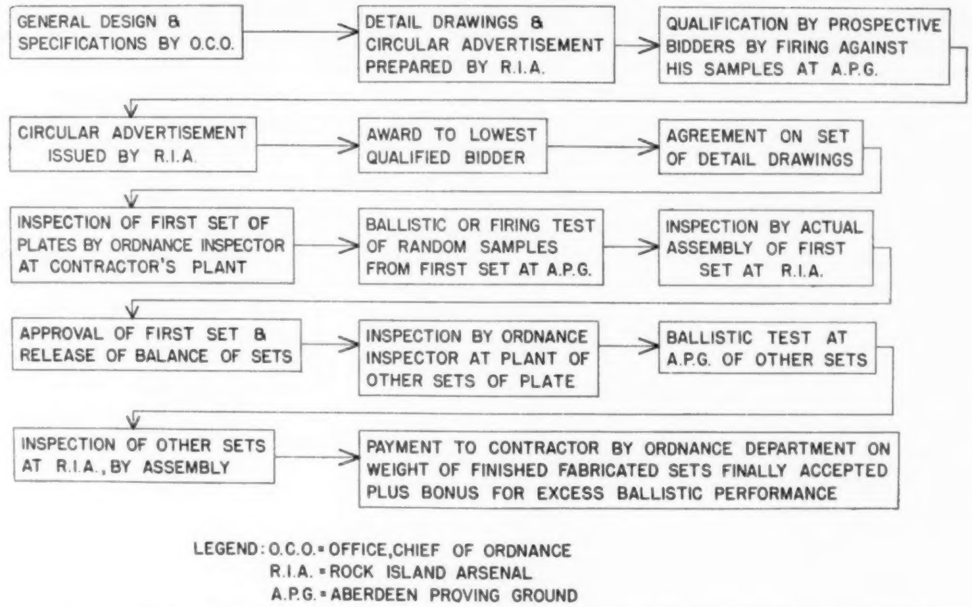

FIG. 8 STEPS TAKEN BY THE U. S. ORDNANCE DEPARTMENT IN THE PROCUREMENT OF TANK ARMOR PLATE

After acceptance of the article at the manufacturer's plant, it is shipped to the arsenal where a final inspection takes place. In addition to an inspection as to the condition and completeness of the shipment, the final inspection varies with the nature of the article inspected; for example, in the case of transmissions a final running-in mechanical check and noise test are made at the arsenal.

One of the most difficult items to procure is the armor plate, and, as an example of the items procured commercially, the manner of obtaining this important item will be discussed in more detail. Fig. 8 shows the general steps that are taken in this procurement. The specification is a performance specification, that is, the contractor is required to furnish a plate of a certain thickness which will keep out our standard armor-piercing projectiles at certain velocities. He is thus perfectly free to use any composition, heat-treatment or other process he may wish, and has only to meet the firing test. This is conducted by the Ordnance Department, in his presence, at Aberdeen Proving Ground, Maryland. In addition, as an incentive to improvement of the plate, the contractor is paid a 5 per cent bonus for each 150 fps that his plate is better than the specification. Fig. 9 shows the ballistic requirements of plate purchased some years ago. The final criterion in the accept-

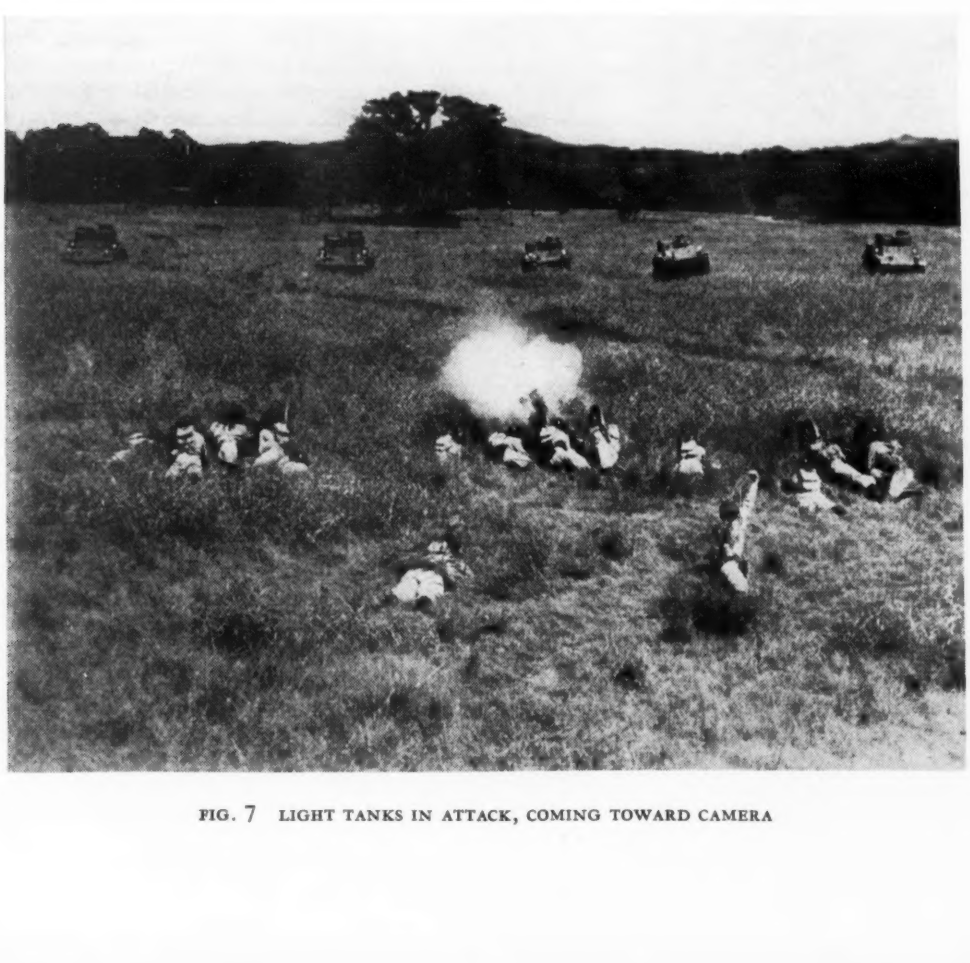

FIG. 7 LIGHT TANKS IN ATTACK, COMING TOWARD CAMERA

ance of the fabricated plate is whether it can be assembled into a complete tank hull at the arsenal. This system of final inspection has been found fairer to all concerned and less expensive than to make all the plates conform exactly to the toleranced drawings. It is of interest to note here that the procurement of armor plate over a period of years has resulted in a marked increase in the quality, and a marked decrease in the price, of armor plate, because both the steel industry and the Ordnance Department have learned from practical experience of procurement and manufacture how best to design and how to make the individual pieces. We are currently paying about 83 cents a pound for fabricated face-hardened armor plate as used in this tank. The manufacture of armor plate is a difficult matter and very much of a specialty. There is no doubt that in a time of national emergency the

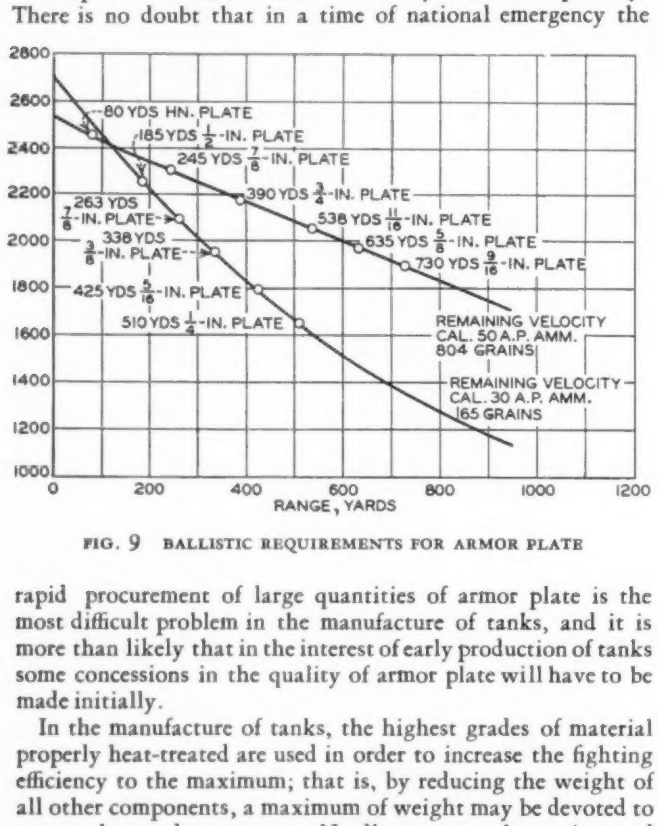

FIG. 9 BALLISTIC REQUIREMENTS FOR ARMOR PLATE

rapid procurement of large quantities of armor plate is the most difficult problem in the manufacture of tanks, and it is more than likely that in the interest of early production of tanks some concessions in the quality of armor plate will have to be made initially.

In the manufacture of tanks, the highest grades of material properly heat-treated are used in order to increase the fighting efficiency to the maximum; that is, by reducing the weight of all other components, a maximum of weight may be devoted to armor plate and armament. Needless to say, the engine used in the tank is of the highest quality of materials and workmanship. In the rest of the tank, no cast iron is used, and heat-treated steel castings, only where necessary, are used; some of the latter are armor-type castings of the highest quality obtainable. Aside from these, heat-treated alloy steels are used with special reference to resistance to shock and fatigue, although in some places (such as in the suspensions) surface hardening to resist wear is of greatest importance. Aluminum alloys are used, to save weight, for transmission cases, ammunition racks, and other interior fittings. Welding is used extensively, except on the armor plate. Where rivets cannot be used, self-locking nuts, lock washers, and cotter pins are used to prevent loosening due to the severe shocks and vibration to which the tank is subjected.

Certain other groups of components of the tank are manufactured at the arsenal. In this category are the metallic parts of the tracks, the suspensions, the clutch, flywheel, and fan for the engine, the turret traversing mechanisms, the controls, the gun mounts, ammunition racks, some machine guns, and many minor parts. For these items, the arsenal buys raw material to specifications from the private industries, and performs the manufacturing operations in the arsenal in conformity with detail drawings. For this class of material an elaborate and varied inspection system operates within the arsenal directly under the commanding officer, and not under the control of that part of the arsenal responsible for manufacture. The arsenal commander thus has a wholly independent check on the operations of his manufacturing division.

The arsenal's planning room schedules the work in the arsenal's shops, and the deliveries of the components from private sources, in such a way that there will be available in the manufacturing stores at the arsenal all the parts necessary to assemble tanks in the assembling section of the arsenal. This assembly is at uniform rate to meet a monthly delivery schedule promised to the War Department when the order for tanks is placed. It will be of interest to know that during the last couple of years Rock Island Arsenal has successfully, with one or two minor exceptions, met all of its estimated deliveries.

The assembly operation starts with the assembly of the hull or chassis of the tank, which is wholly composed of armor plate. These hulls are assembled progressively on a series of horses in one wing of the arsenal, the plates being assembled by riveting in place carbon-steel angles and butt straps. The holes in these are located by using the armor plates as jigs.

The next operation is the installation of the transmission in the forward end of the vehicle at the same time that the engine with its fan, flywheel, and clutch are being installed in the engine compartment at the rear of the vehicle. Prior to the installation of the engine, the assembly consisting of the fan, the flywheel, and the clutch has been statically and dynamically balanced at the arsenal before assembly on the engine crankshaft. The steel track links are brazed together automatically at the arsenal, then shipped to a rubber company to have the rubber pads vulcanized to them. When the shoes are returned they are assembled at Rock Island Arsenal with rubber-bushed pins into a continuous track. After assembly, the tank is given a 75-mile operation on the arsenal reservation under its own power as a shop test prior to its final inspection and shipment. After this shop test, operation adjustments are made and the tank is thoroughly cleaned and painted in a spray booth.

The especially difficult components of the tank from a procurement standpoint, both in peace and war, are the armor plate, the engines, the transmissions, and the rubber components. This is because these components require (1) specialized knowledge and experience on the part of the manufacturer and (2) special facilities which are distinctly limited. That this is the case with respect to these components even in time of peace, when the industries are not busy or prosperous, is indicated by the fact that although these components are procured by wide circular advertising very few acceptable bids are obtained (and very few unacceptable ones also). Even as it is, some of the contractors who now bid on, or have furnished, the above components, may be said virtually to have set up a special activity for furnishing these components to the Ordnance Department, since there is practically no civil market for such equipment. Since the annual requirements of the Army, measured by industrial standards, are small and necessarily fluctuate from year to year with the appropriations received, many firms will not interest themselves in doing such highly specialized work. This is one of the primary reasons why tanks as a whole (as well as some other items of ordnance equipment) are basically manufactured in our arsenals, in such a way that there may be put out for private procurement at any time all those components which can be economically and promptly obtained from private sources. The remaining components are then made and the assembly done at the arsenal. The components which can be so obtained vary from time to time with the state of business, the size of the order, and the type of equipment to be procured.

In this respect we are at a distinct disadvantage as compared to other industrial nations which have a private munitions industry continuously engaged in the manufacture of armament, and this situation has an important bearing both on peacetime and wartime production of tanks and other items of ordnance. A fairly uniform annual program of tank manufacture would help enormously both as to development and costs of manufacture.

This paper would be incomplete without some discussion of costs. Without going into details, it can be stated that the costs of our tanks, produced as they now are in limited-quantity manufacture, are reasonable; the cost amounts to about \$1 per lb without armament, and about \$1.25 per lb if the armament be included. While this may appear very high compared to the cost per pound of cheap motorcars, this is not a fair comparison. A fair comparison would be with high-grade automobiles, machine tools, electrical equipment, and airplanes. Table 4 lists the percentage by weight of the various major

TABLE 4 WEIGHTS OF VARIOUS MAJOR COMPONENTS OF THE U. S. LIGHT TANK

Component or group	Weight of components, lb	Per cent of total weight
Hull, armor plate	6277	32.40
Engine and accessories	1054	5.45
Transmission, including clutch	1261	6.50
Final drive	1263	6.50
Tracks	2500	12.90
Suspensions	3012	15.50
Fuel and tanks	467	2.40
Armament	299	1.55
Ammunition	767	3.95
Crew and packs	800	4.10
Radio	116	0.60
Accessories and miscellaneous	1584	8.15
Total	19400	100.00

components in relation to the tank as a whole, from which an idea of the relative amounts of costs involved in the various subassemblies may be obtained.

Attention is called to the wide range of industries involved in the production of a tank, that is, the primary industries only, without going back to the semifinished- and raw-material industries behind all these. The following industries contribute to the construction of a tank: Steel, engine, automotive parts (transmission), automotive accessories, airplane accessories, rubber, antifriction bearings, electrical, aluminum, and radio. The raw material principally involved is, of course, steel, with rubber a close second in its relative importance to the success of the tank, but not in the quantity used.

The tanks we are developing and building now are, of course, for the small army which we now have. An army must always be thinking of the ultimate object for which it is being maintained, that is, war; therefore, in our current manufacture we must always bear in mind two things: First, the fact that the tank is to be used in war, and, second, that in time of war very large quantities will be needed in the shortest practicable time.

A further idea as to the requirements may be obtained from the fact that when the World War armistice was signed there were on order for the United States over 23,000 tanks of the various sizes, but this was 20 years ago when the tank was far from established as a military weapon. A further indication of tank production may be obtained from Table 1, which shows the number of tanks known to be on hand at the present time in foreign countries, to which may be added the information that all of those countries are now engaged in the manufacture of additional tanks.

It is anticipated that even with the most enthusiastic cooperation of our great industries, the quantity production of tanks would be a long time getting under way. Estimates made by experienced personnel inside and outside of government service now vary from five months to a year to begin deliveries of tanks after the declaration of war. This engrossing subject probably will never be settled with academic discussions; but Fig. 10, which is based on actual results obtained by the French government when they were threatened by extinction in the World War, may be of interest as reinforcing what might be called a conservative and historical view, with which the

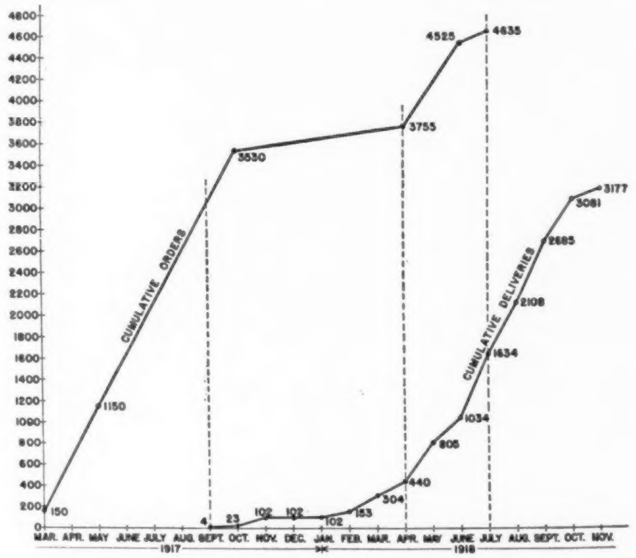

FIG. 10 FRENCH TANK PRODUCTION FOR 1917–1918

author is in agreement. Aside from the difficulties enumerated as to procuring certain special components even in time of peace there is a special wartime difficulty; that is, the one concerning requirements which are in serious competition with the requirements of other military activities.

CONCLUSION

The author has endeavored to give a brief survey of the status of our National Defense with respect to one major weapon of modern mechanical warfare, which can be summarized as follows:

(*a*) The tank is a major weapon of modern machine warfare like the airplane or the fighting ship.

(*b*) Our tanks are now designed by the Ordnance Department and assembled at Rock Island Arsenal from components mostly manufactured by private firms.

(*c*) Being a complex weapon, representing the integrated efforts of many industries, it will be difficult and slow to place tanks in quantity production.

(*d*) Large numbers of tanks will be needed and their losses may be expected to be high, but it is expected that losses in tanks will, to a very large extent, replace losses in man power.

(*e*) The tank is still comparatively new, and much additional development including the building of much larger tanks may reasonably be expected.

(*f*) Technically, the tanks of our army are equal, and in some respects superior, to any other tanks in the world.

(*g*) Whenever it can tactically take the place of fighting men, the tank is much cheaper to use than men, even disregarding the intangible losses to the nation when its young men are killed and wounded.

A MAGNETIC FLOWMETER

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MAGNETS have been used as a part of some recording flowmeters for many years. The metering element in flowmeters of this type is generally a venturi tube, an orifice plate, or a flow nozzle; the magnet is used only as a magnetic clutch or switch in the recording mechanism.

The magnetic flowmeter described in this paper is, as far as the author knows, a new instrument, although utilizing old principles, for determining the rate of flow of fluids in a pipe. It consists essentially of a short length of horizontal non-magnetic pipe inside of which is suspended a bar magnet by one end from a brass plug screwed in the top of the pipe. Fig. 1 shows one of the magnet-and-plug assemblies used in a 3-in. pipe. A carefully balanced magnetized steel needle, shown in Fig. 2, is placed outside the pipe in such a position that it will indicate the deflection of the magnet inside the pipe, which deflection is caused by the flowing water. There is no mechanical connection between the magnet inside the pipe and the needle outside the pipe. The water flowing against the magnet causes it to move or deflect as a pendulum. The magnetic forces of the magnet pull the balanced steel needle outside the pipe to the same position as the magnet.

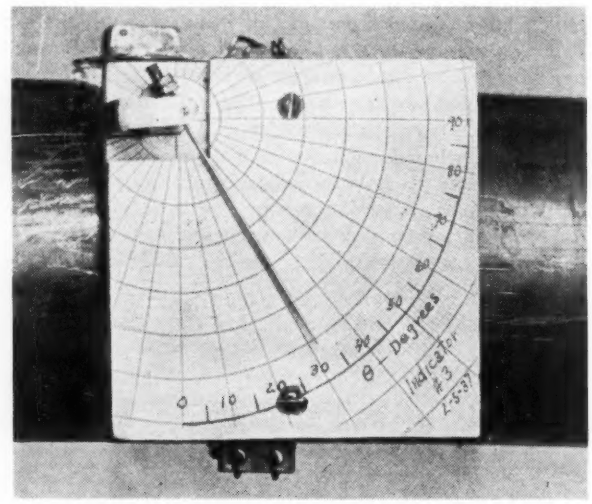

FIG. 2 INDICATING MECHANISM OR INDICATOR

APPARATUS AND METHOD OF TESTING

This meter has been used and tested in four pipe lines of 1-in., 2-in., 3-in., and 8-in. diameter, respectively. In the 1-in., 2-in., and 3-in. lines the meter was installed in a 10-ft section of brass pipe, while in the 8-in. line it was installed in a 5-ft length of pipe made of cement and asbestos. In all four installations the length of the unobstructed straight pipe upstream from the meters was over 100 diameters and the discharge was controlled by a valve located at least 8 diameters downstream from the meter. The water was taken from a standpipe 6 ft in diameter and 65 ft high near the top of which was a weir over which water flowed continuously during the tests, thereby maintaining constant pressure in the standpipe. The available static head for the tests in the 8-in. pipe line was approximately 50 ft; for all other tests it was about 60 ft. The discharge was measured volumetrically in a calibrated tank 8 ft in diameter for the tests in the 8-in. pipe and by weighing for the tests in the smaller sizes of pipe. The time was taken by means of a stop watch.

FIG. 1 MAGNET-AND-PLUG ASSEMBLY

In placing the magnet-and-plug assembly in the pipe considerable care was taken to align the magnet so it would swing freely in the direction of the flow of the water. All parts of the assembly were of brass except the magnets. A total of 14 magnets was used in the experiments. The most satisfactory ones found were those made of Alnico, a material having great pole strength per unit area of cross section. A magnet as strong as possible was desired so that the needle of the indicator on the outside of the pipe would follow closely the movements of the magnet inside of the pipe. All parts of the indicating mechanism or indicator were of non-magnetic material except the needle. It was necessary to use great care in placing the indicator on the pipe so that the shaft on which the needle rotated was colinear with the shaft about which the magnet rotated. The resistance due to friction in the bearings of the magnet and the needle was practically negligible. The temperature of the water was approximately 68 F in all tests.

THEORY OF THE MAGNETIC FLOWMETER

A somewhat approximate analysis of the relation between the velocity of the flowing fluid and the deflection of the magnet will be made using Fig. 3 and the following notation:

V = average velocity of fluid, fps
L = length of magnet, ft
b = breadth of magnet, ft
t = thickness of magnet, ft
θ = angle of deflection of magnet, deg
g = acceleration due to gravity, ft per sec per sec
w = weight of water, lb per cu ft
w' = weight of magnet, lb per cu ft
W = total weight of magnet, lb
F = total buoyancy force on magnet, lb
P = total dynamic force of moving fluid acting on magnet, lb

Fig. 3 shows a magnet suspended in a pipe and the three resultant forces acting P, F, and W on it. The magnet is deflected through an angle θ, caused by the average velocity V of the fluid. The velocity is assumed to be uniformly distributed over

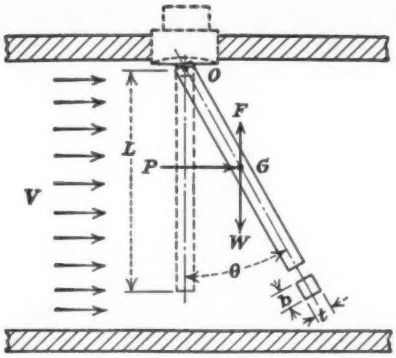

FIG. 3 MAGNET SUSPENDED IN A PIPE

the entire cross section of the pipe. While this assumption is not true in general, it is close to the actual conditions during turbulent flow. Since the velocity is assumed uniformly distributed, the force P and also forces F and W will act through the mass center G of the magnet, as shown in Fig. 3. By applying the principle of mechanics that impulse is equal to the change in momentum and considering a time of 1 sec, we obtain the equation

$$P = (w/g)VbL \cos\theta\,(V - 0) \qquad [1]$$

Since the magnet is in equilibrium, the sum of the moments of the forces about the axis of rotation must equal zero. Hence

$$P\frac{L}{2}\cos\theta + F\frac{L}{2}\sin\theta - W\frac{L}{2}\sin\theta = 0 \qquad [2]$$

By substituting Equation [1] in Equation [2] and simplifying, the following expressions for the average velocity in the pipe may be obtained

$$V = \sqrt{\left[\frac{(W-F)g}{wbL}\right]}\ \sqrt{\left(\frac{\tan\theta}{\cos\theta}\right)} \qquad [3]$$

or

$$V = \sqrt{\left[\frac{(w'-w)tg}{w}\right]}\ \sqrt{\left(\frac{\tan\theta}{\cos\theta}\right)} \qquad [4]$$

Thus, for any individual magnet, Equation [4] may be generalized as

$$V = Kf(\theta) \qquad [5]$$

in which K is a constant depending on the dimensions of the magnet, the density of the magnet and of the fluid, and in which $f(\theta)$ is equal to $\sqrt{(\tan\theta/\cos\theta)}$. It is well to note that Equations [4] and [5] do not involve the length of the magnet, and that the thickness t, or dimension of the magnet parallel to the deflection, is the important one.

RESULTS

A comparison between the theoretical curves, as computed from Equation [4], and the experimental data obtained from the flowmeters used in the 3-in. and 8-in. pipes is shown in Fig. 4.

The data shown for the 3-in. pipe are those taken when using magnets of similar shape but of different lengths. These data compare favorably with the theoretical curve up to a deflection of the magnets of about 75 deg, which corresponds to an average velocity of the water of approximately 8 fps. Other sizes and shapes of magnets were used in this pipe with the same success.

The data shown for the 8-in. pipe are for magnets of the same length but of different cross-sectional shape. The rectangular magnet was suspended so that the water impinged against the $^1/_2$-in. or narrow side. These data tend to indicate the correctness of Equation [4] in that the thickness is the controlling dimension of the magnet in the magnetic flowmeter.

Magnets of various shapes and sizes were also tested in the 1-in. and 2-in. pipes, and a somewhat lower limit of accuracy was found than in the 3-in. pipe.

In all four sizes of pipes used in this investigation, the test data showed that the magnetic flowmeter gave very reliable results when the angle of deflection of the magnet was less than 50 deg. This deflection corresponded to an average velocity of approximately 6 fps. The loss in head due to the meter was measured by a differential gage and was found to be negligible.

FIG. 4 THEORETICAL CURVE AND TEST DATA FOR 3-IN. AND 8-IN. PIPES, SHOWING THE RELATION BETWEEN THE VELOCITY OF THE WATER AND THE DEFLECTION OF THE MAGNET IN THE MAGNETIC FLOWMETER

ACKNOWLEDGMENTS

This investigation was carried out at the University of Illinois in the hydraulic laboratory of the department of theoretical and applied mechanics of which Professor F. B. Seely is the head. The writer is especially indebted to Herbert J. McSkimin who, in fulfilling the requirements for student thesis work, built the first indicator and made many of the tests on the smaller pipes.

A Simplified PITOT-TUBE TRAVERSE

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IN PLANT test work the pitot tube is probably used more generally than any other instrument for measuring fluid-flow rates in pipes and ducts, particularly in those of large size. Because the instrument gives the velocity at a point, it is necessary to make an exploration over the cross section of the duct and then obtain the total flow by an integration over the total cross-sectional area. In round conduits this is usually done by making traverses across one or more diameters with an assumption of uniform flow at all points at the same radius in the sector represented by the radial traverse. When a traverse across only one diameter is made, the integration implicitly assumes constant fluid velocity at any radius for each half of the duct. Except in cases of unusual distortion of flow, due to bends, valves, or other obstructions in the duct, this procedure gives results with an accuracy satisfactory for plant work.

Based on a single traverse, the total flow q is obtained as

$$q = \pi \int_{-R}^{+R} urdr = \frac{\pi R^2}{2} \int_{-1}^{+1} ud\left(\frac{r}{R}\right)^2 \ldots\ldots [1]$$

The numerical result is obtained by a graphical integration, employing a plot of the velocity u versus $(r/R)^2$. An alternative procedure (1)[1] is to measure the velocity at ten points representing half-rings of equal area, in which case the average velocity is one tenth of the sum of the ten measured velocities. The readings are taken at values of $(r/R)^2$ of 0.1, 0.3, 0.5, 0.7, and 0.9, which correspond to positions across a diameter of 2.6, 8.2, 14.6, 22.6, 34.2, 65.8, 77.4, 85.4, 91.8, and 97.4 per cent of the distance from one wall to the other. This procedure involving a ten-point traverse is widely followed in practice.

Although various procedures may be followed in carrying out the necessary integration, Gauss's method of numerical integration (2, 3) would seem particularly suitable for the problem at hand. Gauss's method does not appear to be familiar to many engineers, although for many practical uses it would appear to be simpler and better than Simpson's rule or graphical integration.

The method provides a means of obtaining the average value of a function $f(y)$ over a definite interval of x by noting values of y at n values of x, multiplying each value of y by a predetermined constant, and adding the products to obtain the average value of the function. The values of x used are predetermined and depend only on the number n of points to be used. The method is exact if the function can be represented by a polynomial of the degree $2n - 1$.

As an illustration, suppose the function is a polynomial of the fifth degree. In order to obtain the exact integral it is necessary to obtain the values of y at three values of x in the interval from $x = a$ to $x = b$. Following the rule given by Gauss, the positions to be used are $z = -\sqrt{(3/5)}$; $z = 0$; and $z = \sqrt{(3/5)}$; where z is a new variable defined so that $z = -1$ at $x = a$, and $z = +1$ at $x = b$. The observed values of y at these values of x (or z) are multiplied by $^5/_{18}$, $^4/_9$, and $^5/_{18}$, respectively, and the sum of the products represents the average value of y over the interval a, b. The integral is $(b - a)$ times this average value.

For the general case of n points, values of $y_1, y_2 \ldots y_n$ are determined at $z_1, z_2 \ldots z_n$, and multiplied by constants $K_1, K_2 \ldots K_n$. The integral is $(b - a)(K_1y_1 + K_2y_2 + \ldots K_ny_n)$. Values of z and K have been calculated for various values of n and are given here for $n = 3$ and $n = 4$:

For $n = 3$: $z_1 = -\sqrt{(3/5)}$; $z_2 = 0$, $z_3 = \sqrt{(3/5)}$
$K_1 = K_3 = 5/18$; $K_2 = 4/9$

For $n = 4$: $z_1 = -0.86114$; $z_2 = -0.33998$
$z_3 = 0.33998$; $z_4 = 0.86114$
$K_1 = K_4 = 0.17393$; $K_2 = K_3 = 0.32607$

The application of the method to a pitot-tube traverse is quite simple, as the problem is simply the evaluation of the average value of u on a plot of u versus $(r/R)^2$. The variable $(r/R)^2$ does not have to be changed, as the limits are already +1 and −1. If the three-point method is used the velocity u is measured at $(r/R)^2 = -\sqrt{(3/5)}$ and $\sqrt{(3/5)}$; and at the center of the duct. The values correspond to the center and two points at a radius of 0.880 R. The velocity at the center is multiplied by $^4/_9$, and the other two observed velocities are multiplied by $^5/_{18}$. The sum of the three products is the average velocity through the duct.

If four points are used the readings are taken two at 0.928 R, and two at 0.583 R. The two nearest the wall are multiplied by 0.17393, and the two nearest the center are multiplied by 0.32607. The sum of the four products is the average velocity in the duct.

It was pointed out that the three-point method is exact if the velocity function can be fitted by a fifth-degree polynomial, and the four-point method is exact for a seventh-degree function. The accuracy of a three- or four-point pitot-tube traverse carried out as suggested will obviously depend entirely on how nearly the relation between u and $(r/R)^2$ can be fitted by a fifth- or a seventh-degree equation. It seems reasonable to expect, however, that for most flow conditions the velocity relation would be a sufficiently simple function so that these procedures might be used to advantage.

Since the value of the proposed simplified traverse rests entirely on the complexity of the velocity distributions encountered in practice, it is necessary to test it by use in connection with data on observed traverses. For this purpose data were collected on flow conditions in conduits operating under a wide variety of conditions in a steel plant, a paper mill, and a chemical plant. In most cases the usual ten-point traverse had been employed. The velocities were plotted versus $(r/R)^2$ and the average velocity was obtained by graphical integration. The Gauss method, using three and four points, was also used; values of u at the specified positions across the diameter were obtained from smooth curves drawn through the velocity measurements.

Fig. 1 shows the traverses obtained, plotted as u versus r/R. Table 1 indicates the conditions of the test and tabulates the average velocity as obtained by the four procedures. The graphical integration may be taken as the standard for comparison, although it should be realized that the comparison made refers only to the accuracy of integration across one diameter. If the flow in each half of the duct is not symmetrical radially, the average velocity as calculated will not be correct, even though the method of integration is exact. Under such conditions traverses across two or more diameters should be employed.

As indicated by the table, the data cover a wide range of con-

[1] Numbers in parentheses refer to the Bibliography.

TABLE 1 COMPARISON OF AVERAGE VELOCITIES CALCULATED BY VARIOUS METHODS

Test	Fluid	Duct diameter, ft	Fluid density, lb per cu ft	Average velocity, fps: By graphical integration	10-point	3-point Gauss	4-point Gauss	Location of traverse
A	Air	2.17	0.071	51.2	52.1	50.5	51.9	Air to preheater in billet reheater.
B	Air	2.66	0.077	21.7	21.7	21.6	21.5	6 in. downstream from open inlet.
C	Blast-furnace gas	6.33	0.078	62.0	62.3	63.9	61.7	19 diam downstream from 45° bend.
D	Air	2.0	0.075	43.5	43.7	44.0	43.4	5 diam downstream from right-angle bend.
E	Air	1.05	0.073	25.1	25.2	25.1	25.3	4 diam downstream from blower.
F	Air	1.05	0.073	26.7	26.7	26.6	26.8	20 diam downstream from right-angle bend.
G	Water	0.33	62.3	10.9	10.9	10.9	10.8	25 diam downstream from bend.
H	Water	0.33	62.3	11.2	11.2	11.4	11.1	25 diam downstream from bend.
I	Sulphur-burner gas	1.46	0.076	23.8	23.8	24.2	23.7	34 diam straight pipe upstream.
J	Water	0.51	62.3	1.57	1.57	1.59	1.52	
K	Water	0.51	62.3	1.79	1.80	1.84	1.79	
L	Blast-furnace gas	3.0	0.078	13.5	13.5	13.6	13.5	Straight length of gas main.
M	Air	4.17	0.069	50.1	50.5	48.6	50.9	Immediately downstream from butterfly valve.
N	Blast-furnace gas	2.0	0.077	57.1	57.4	57.1	58.5	3 diam after one bend and just above another.
O	Air	1.54	0.059	54.1	54.0	54.2	54.0	{Downstream from a fan in a straight section.
P	Hot air	1.5	0.053	39.6	39.6	39.9	39.6	
Q	Air	1.94	0.075	39.0	39.2	39.6	39.0	{8 diam downstream and 2 diam upstream from bends.
R	HCl-air, 44% HCl	0.83	0.0829	27.5	27.6	27.6	27.6	5 diam downstream from bend.
Average error as compared with graphical integration, per cent . . .					0.25	1.1	0.8	

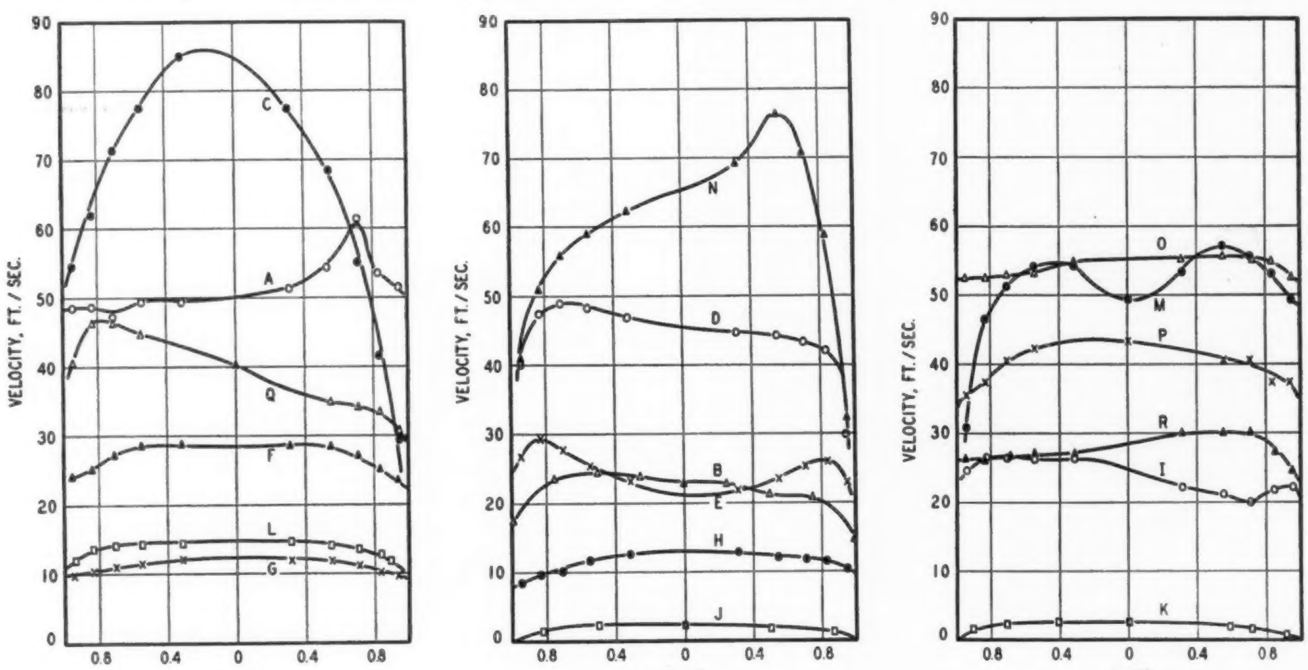

FIG. 1 PITOT-TUBE TRAVERSES CORRESPONDING TO TABLE 1

ditions, some quite extreme. They are probably typical of plant tests, however, for it is usually necessary to measure the flow under conditions which are far from ideal. Probably the only excuse for making a traverse immediately downstream from a butterfly valve is that there is absolutely no other location possible. Even in this extreme case, however, the application of the Gauss method gives results which are within the probable error of the data.

The average deviation (without regard to sign) from the values obtained by graphical integration is 1.1 per cent for the three-point method and 0.8 per cent for the four-point method. The corresponding maximum errors are 3.0 per cent (test M) and 3.2 per cent (test J). It would appear that the four-point and, in many cases, the three-point Gauss method gives results of sufficient accuracy for plant tests, with considerably less trouble than the usual ten-point traverse.

Thanks are due the students of the School of Chemical Engineering Practice, who carried out the pitot-tube traverses in connection with various plant test programs.

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COMMEMORATION *of the* CENTENARY *of* PHOTOGRAPHY[1]

IT IS A hundred and sixteen years since photography was invented by Nicéphore Niepce, of Chalon-sur-Saône, France, but it is only a century since it was given to the public. As a matter of fact it was on Jan. 7, 1839, at a meeting of the Académie des Sciences, that the subject was mentioned for the first time. The inventor, Niepce, had been dead five years, but he left behind him an associate, Daguerre, who was already well known by his Diorama, and to Daguerre was left the task of perfecting the discovery of Niepce.

Niepce, in his association with Daguerre in 1829, had revealed to his partner the secret of his process, in which he employed silvered copper plates, iodine, and bitumen of Judea. His process, however, was too slow for practical use, requiring eight hours of exposure in full sunlight. To Daguerre belongs the merit of discovering the use of silver iodide, which made possible exposures of not more than thirty minutes and, under certain favorable conditions, only twelve minutes.

NICEPHORE NIEPCE (1765–1833)

It is difficult to understand, today, that Daguerre and Niepce's son, who had succeeded to his father's interest in the partnership, could find no financial support for the exploitation of their invention. No business man could be found who would risk a penny on the future of photography.

We have arrived at the end of the year 1838. Daguerre now approached Arago and showed him the first daguerreotypes. It did not take the great scientist long to appreciate the possibilities of the new invention, and he made it the subject of an enthusiastic address to the Académie des Sciences on Jan. 7, 1839. This communication was republished in the scientific periodicals of all countries and excited great interest in the world of science. Following the Englishman Fox Talbot's claim to priority of invention, a lively controversy ensued, in which some took Talbot's part while others defended the claims of Daguerre. No one, however, remained indifferent; many, incredulous, demanding proof before accepting the great discovery.

We see now arriving in Paris during the early months of 1839, Herschel, Watt, Claudet, Forbes, Murchison coming from London; Sachse from Berlin; Ettingshausen from Austria; Jobard from Brussels; and DeHamel from far Russia. Consider the difficulties of such long journeys in 1839. We must not forget to mention the presence in Paris of the American painter, Morse, the inventor of the electric telegraph, who had arrived earlier for the purpose of promoting his own invention. These men were generous in expressing their astonishment and their admiration for what seemed to promise certain success.

Urged by all this agitation and clamor, the French government, for the first time in the history of invention, introduced a law awarding a national compensation to the inventors, with the condition that their secret process was to be divulged for public use. Accordingly, at a joint session of the Académie des Sciences and the Académie des Beaux Arts, on Aug. 19, 1839, Arago made a detailed announcement of the daguerreotype process.

With what impatience was this revelation awaited, and with what enthusiasm was it acclaimed. The accounts of those present confirms this. One needs but to read the pages of Abbé Moigno to appreciate this universal interest.

Erich Stenger, in his studies on the daguerreotype, relates the experience of a German, Ludwig Pfau, who was present in Paris at the time and shared the common enthusiasm:

"Two hours before the beginning of the session the hall was packed to the doors; the vestibule was no less crowded, pressed on every side by an outside crowd equally curious to learn something of Daguerre's discovery.

"Presently a door opened, an assistant appeared, and to those outside awaiting the revelation of the mystery he announced: 'The whole thing consists of the use of oil of lavender and bitumen of Judea.' One can imagine the surprise of the thousands of persons provoked by these words. . . But, patience! The door again opens and one of the audience appears, announcing: 'It is a matter of iodine, mercury, and hyposulphite of soda!' These contradictory statements doubtless resulted from the eagerness of the listeners who, too impatient to wait the end of Arago's address, hastened to inform those less fortunate outside the vestibule."

We could cite twenty similar experiences. With the same impatience, I might say with the same anxiety, the news was awaited in Berlin, London, Geneva, Brussels, Barcelona, Genoa, Naples, etc. From all countries orders for apparatus were received by Giroux, the official manufacturer appointed by Daguerre; and he, overwhelmed by the flood of these orders, was obliged to reduce the quantities ordered. It resulted that, in the frantic effort to satisfy everybody, many hurried and defective shipments were made.

[1] Articles by Georges Potonniée in the *Petite Chronique Mensuelle* of the Société Française de Photographie, October and November, 1938. Translated by Edward Epstean, member A.S.M.E.

Such curiosity and so vivid an interest can be explained only by the importance and unexpected character of the discovery. A member of the Académie at that time expressed the general surprise as follows: "When Daguerreotypes were first spoken of we reacted to this novelty as to a fable invented for our entertainment, had men of superior knowledge who had seen them not assured us that they were a reality."

Arago did not deceive himself about the future in store for photography. Of course, it was impossible for him to foresee all—that it would some day reproduce, as it does today, although still incompletely, all the aspects of life, its movement, color, and relief. But he did perceive that nature had created it with the inherent ability to perfect itself, and even with the means by which it would transform itself. He had an indefinable belief in its rapidity, and its marvelous power of retaining the light rays received, so that, at the end of a certain period, it would record that which it had not seen at first. One of the properties of photography escaped him, at that time wholly unknown, the sensitivity of those radiations which are invisible to us. It was because he envisioned all this that Arago addressed these impressive words to the French Deputies during the debate of the proposed law: "You will approve the motive which has dictated this agreement. You will associate yourselves with an idea which has excited universal sympathy. You will not permit that we allow a foreign nation the glory of endowing the world with one of the most marvelous of discoveries by which our country is honoured."

The hundredth anniversary of this astonishing first appearance of photography will fall on Jan. 7, 1939. Perhaps the French government will note this date, and will not permit individuals to usurp its privilege of celebrating this glorious gesture of France, in offering, a hundred years ago, photography "generously to the world." This, also, is Arago's phrase.

We appeal to all those, in every country, who are interested in photography, as amateurs, professionals, or as users of its varied products, to join us, constructively, in this celebration.

A month ago I wrote that from the day when photography was first made public, Aug. 19, 1839—the day when it was no longer the invention and property of one man but given to everyone, an acquisition to universal science—the discovery spread with extreme rapidity. By the end of September, 1839, daguerreotypes were made in New York and Boston. Considering the time consumed by an overseas voyage a century ago and the distance of these cities from Paris, the haste with which the new process was taken up is astonishing. Of course the countries of Europe knew of the daguerreotype somewhat earlier, especially near-by Belgium and Switzerland where French was the national language and where it spread as quickly as in France. In Berlin Daguerre's apparatus and instructions arrived on September 6. Long before this date, however, the Germans attempted to make daguerreotypes, using whatever means were at hand and following the information given by Arago at the session of August 19. Other countries followed quickly. There is no doubt that by the end of 1839 the daguerreotype was known and practiced all over the world.

Daguerre's brochure containing the inventor's instructions had been translated in England, America, Holland, Sweden, Poland, Hungary, Germany, Austria, Italy, Spain, etc. Dr. Erich Stenger cites twenty-two editions of this brochure in foreign languages in Europe alone, published before the end of 1839. Epstean, in his study, "The Daguerreotype in the United States," mentions a translation of Daguerre's pamphlet in October, 1839. Some days later, the Frenchman Gouraud, calling himself Daguerre's agent, landed in New York and gave instructions in photography. Dr. Stenger, therefore, has good reason for asserting that there is no other instance in which a small publication of this kind has spread throughout the world with such rapidity. He adds, "This was a foreshadowing of the triumphant progress of photography, from which humanity was to derive the greatest benefit."

The triumphant march of photography has continued because of the cooperation of scientists the world over, who, from the beginning, by their persistent research over a century, contributed improvements without which photography must have lagged in achieving its present perfection. There is space here for enumerating only the most important of these achievements. The most notable of these, thus far holding its pre-eminence in its field, is the increased rapidity and consequent shortening of exposure. I have mentioned that the earlier exposure required from twelve to thirty minutes. Two years later, by the use of silver bromide, the time was reduced to one or two minutes. Goddard in America, Talbot in England, Natterer in Germany,

LOUIS JACQUES MANDE DAGUERRE (1789–1851)

each claim priority in the use of bromine. May I include my countryman Fizeau and thus include France among these splendid contributors to the development of photography.

Photography on paper, consisting of a paper negative taken in the camera and a positive print made by contact, invented by Fox Talbot, began to displace the daguerreotype at the end of 1847, influenced by the processes of Niepce, de St. Victor, and Blanquart-Evrard. Scott Archer's collodion process (1851) reduced the time of exposure to a fraction of a minute. This process marks a long period without radical change and remained in use until about 1880. At this time the use of the gelatin silver-bromide dry plate spread from England to the Continent and we became familiar with the extremely short exposures called "instantaneous." The Englishman Bennett disclosed in 1878 a method—ripening—which resulted in increased rapidity of emulsions. In that year the industrial era in photog-

raphy began when plates were first sold ready for exposure, more and more rapid, and with increased sensitivity to all the colors of the spectrum. In France Antoine Lumière, and later his sons Auguste and Louis, stand pre-eminent in the industry as manufacturers of photographic plates. About the year 1900, with Sigriste's camera, exposures of one thousandth of a second were possible, and at present special devices permit one millionth of a second to be exceeded. Let us hope that greater advancement will yet be made, but we must concede that our present progress seems satisfactory to us.

These years showed photography undergoing many other changes. Stereoscopes were first exhibited at the London Exposition of 1851. The Englishman Wheatstone was the first to introduce a somewhat crude stereoscope of a geometrical design, and to another Englishman, David Brewster, is due the merit of creating photographic stereoscopy. After photography in relief came photography in color, and the credit for this belongs wholly to France.

In 1869 Ducos du Hauron invented the indirect or trichromatic process, which was the progenitor of the color processes now in universal use. Gabriel Lippmann made photographs in color by the direct or interference method, perfecting the incomplete experiments of Becquerel.

The most astounding advance made in photography, however, was its achievement in producing the illusion of movement, first known as animated photography—the motion picture. The illustrious name of Louis Lumière will always remain associated with this industry, because it was he, our former president, now our honorary president, who, together with his brother Auguste, showed the first cinematograph in 1895, thus solving a problem which had agitated the world for 60 years. Again, all countries claim priority in the invention of animated photography. The United States claims it for Edison, England for Friese Green, Germany for Skladanowski. Even France cites Marey, Reynaud, Demeny. Then followed a lull; history took account, in the course of which pertinent data were verified and the truth was revealed in its pure and dazzling brilliance. Louis Lumière may now peacefully enjoy his glory. Photography continues to extend its influence. To this hurried account of its progress we must add the reproduction of the voice and of sound in general, and the transmission of the image to distant points. I will merely mention that the first records of sound made by the action of light date from 1901, the work of the great French physicist André Blondel and the first synchronization of image and sound was produced in the same year by Léon Gaumont.

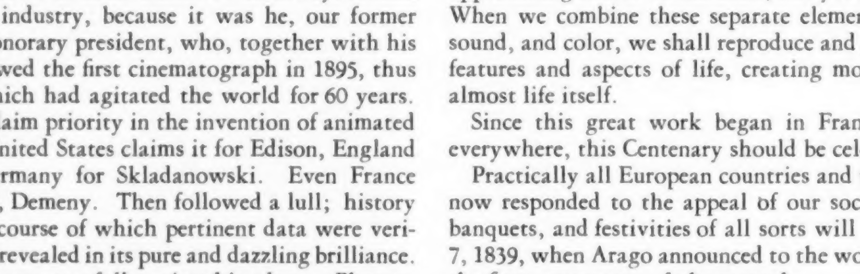
The transmission of images was the outstanding work of the French scientist Edouard Belin who, in 1924, succeeded in transmitting by wireless the first half-tone reproduction of a photograph. The Société Française de Photographie et de Cinématographie is proud to name this scientist as one of its vice-presidents, and of the fact that his first experiments were made in the laboratories of our society.

Owing to lack of space, I have here mentioned only my compatriots, omitting many illustrious names outside of France, whose numbers indicate that photography is the result of international effort, based on a century of research all over the world. Were I to attempt to sketch merely the application of photography to the art of design, to literature, and to experimental science, its universal character would be still more apparent.

However, why enlarge on this subject? My readers are photographers, who know that with photography was born a new art of writing, a new means of graphic expression, ever approaching nearer to the ideal, not yet attained, but in sight. When we combine these separate elements: Relief, movement, sound, and color, we shall reproduce and preserve all the varied features and aspects of life, creating more than a reflection—almost life itself.

Since this great work began in France and was followed everywhere, this Centenary should be celebrated everywhere.

Practically all European countries and the United States have now responded to the appeal of our society, and expositions, banquets, and festivities of all sorts will recall the date of Jan. 7, 1839, when Arago announced to the world the daguerreotype, the first appearance of photography.



"THROUGH THE FURNACE DOOR"
(Photograph by H. R. Limbacher shown at Photographic Exhibit of 1938 A.S.M.E. Annual Meeting.)

PROMISES *and* DEBTS

By DONALD S. TUCKER

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EMOTIONAL APPEAL makes a book more readable. Herein lies the difficulty with many books on economic problems. They are so carefully dispassionate that they lack emotional appeal no matter how lucid their style or how clear and simple their explanations. Books which make an appeal to the emotions may, on the other hand, lack the careful comprehensive statement of fact which is necessary to make them accurate. Rarely has this contrast between two types of description been so beautifully illustrated as by a pair of books which appeared last year. Both chose as their subject the problem of debts and recovery. The dispassionate book is called prosaically "Debts and Recovery." The work in more popular style is entitled "The Promises Men Live By." Because the latter work is the older by a few months it will be examined first.

Mr. Scherman's work[1] has many excellent features: Its author evinces industry; his style has charm; and above all he displays a contagious enthusiasm. Such enthusiasm is refreshing and all too rare. The reader of Mr. Scherman's book is made to feel that he is "on his own" exploring a territory which is novel as well as exciting. One must recognize that if Mr. Scherman's work had followed more orthodox lines, it would have avoided many pitfalls but it would also have made the voyage of discovery seem less adventurous.

The difficulties into which Mr. Scherman's work falls are of many types. It starts with a uniquely simple conception of the problem. Economic life is compared to a tangled ball of twine (p. xxvi). If you find one loose end and patiently pull it through knot after knot, you will, according to this book, unravel the whole ball. Neither here nor elsewhere does this work recognize adequately that the economic tangle contains many pieces of twine. Other institutional factors, the technology of production, and consumers' preferences are each at least as important as debts. In the pursuit of the chosen clue Mr. Scherman's study becomes involved in more serious difficulties.

The theses presented in his first 254 pages are chiefly three: That promises are important in modern business; that long-term promises involve difficulties not present if the terms of a contract are short; and that business enterprises and domestic consumers are trustworthy debtors but governments are not. Economists would agree readily with the first two theses and would wonder only why elaborate explanation and defense were thought necessary; but Mr. Scherman's third thesis is startling. Does it not follow from his view that insurance companies, for example, would find it safer to buy the promises of small building contractors rather than the bonds of our federal government? In discussing government debt Mr. Scherman states (p. 231) "In other words, most of these crucial government promises never get extinguished—except by cancellation." Later (p. 241) he says, "Now curiously, the first of these considerations, honesty, which almost everywhere else is the principal one, plays so slight a rôle in the half-exchanges of governments that it can be ignored, except for philosophical speculation. The cold fact is that men acting together as a community, large or small, are just as dishonest, just as unscrupulous in breaking their promises, as they dare to be at any one time. Governments always, large or small, will get away with what they can, up to the point where the supremacy of the ruling power is endangered. No such thing as personal integrity, the satisfaction of being reliable, and the shame of betraying faith, appear other than microscopically in governmental economics."

Methods of proof are even more amazing. Mr. Scherman's measure of reliability in the case of banks, as Professor Cushing has pointed out elsewhere, is secured by comparing the deposits of closed banks with total debits to individual accounts (which include transfers of deposits) rather than with total deposits. Would not a counterfeit bill, if measured by this method be called 90 per cent honest, provided it passed successfully through nine hands before being detected in its tenth transfer? To prove on the other hand that government promises are unreliable Mr. Scherman changes his methods. The index of reliability described in the foregoing is discontinued. Mathematical ratios are abandoned. The distinction between default and final loss is thrown overboard. The time interval is altered. The municipal-bond defaults which occurred between 1930 and 1935 are cited apparently as proof of unscrupulousness!

The next hundred pages of this book are occupied chiefly by a discussion of money. Mr. Scherman wants a gold standard; but would any economist in advocating a gold standard discuss this problem now without more articulate reference to the purposes of a standard and the problems of attaining a good monetary system? Do pages filled with accusations of past dishonesty really help a reader's comprehension of a complex problem if the author fails to make clear the more serious arguments in favor of devising a sound monetary system for the future? This portion of Mr. Scherman's book is certain, however, to receive some favorable comment because his discussion of money sounds as if we were still fighting the battle of 1896. Men who were active in the sound-money campaign of that year may greet this book with the enthusiasm they would feel for an old friend. Old vote-getting arguments are here presented with the old emotional fervor, though the words of course are new. But did not the sound-money advocates, even in 1896, present some rather more discriminating arguments in favor of a sound currency system?

It is in his final discussion of business cycles, however, that Mr. Scherman's discussion becomes most hopelessly inadequate. For this he should not be censured too severely. So much of our knowledge with respect to business cycles has been acquired within the last thirty years that anyone not familiar with recent economic literature may readily go astray. But, because some picture of the business cycle is necessary for our purposes here, may we not at this point offer four paragraphs of our own in place of Mr. Scherman's description?

Profits are the motive for business activity under a capitalist system. When business costs are low (because rents, wages, or the prices of raw materials and industrial equipment have been reduced) then one condition favorable to business revival has been created. A second prerequisite of prosperity is that there must be some degree of mutual adjustment within the price

[1] "The Promises Men Live By: A New Approach to Economics," by Harry Scherman, Random House, Inc., New York, N. Y., 1938.

One of a series of reviews of current economic literature affecting engineering prepared by members of the department of economics and social science, Massachusetts Institute of Technology, at the request of the Management Division of The American Society of Mechanical Engineers. Opinions expressed are those of the reviewer.

system. Lumber and wheat may both be sufficiently cheap, but if the price of wheat has declined much more than that of lumber, wheat farmers may be unable to purchase their normal quantity of lumber. Some portion of the lumber industry may therefore stagnate. A third condition of prosperity in a capitalist world is that investment in durable goods must seem attractive. This suggests safety as well as low cost and mutual adjustment. Fear of war, revolution, confiscation, unsound credit conditions, or a collapse of security prices would therefore all be serious deterrents to business recovery. Fourth, financial conditions must be such as to permit an expansion of the stream of money income. If banks have already expanded to their legal limit, if bank deposits also are being used actively in business transfers, and if idle savings are scarce, then further expansion of money income is difficult and almost any accident may start contraction. At the outset of periods of general business revival we find, therefore, that business enterprises, private investors, and banks have normally unused reserves. Under these conditions, if any event initiates business expansion, that expansion may spread progressively because it may so readily be financed. Finally, recovery may be stimulated by the appearance of a new and attractive opportunity for investment, as railroads in the eighties or automobiles in the twenties.

According to the view presented in the foregoing, general business recovery could probably never be assigned to a single cause. Prosperity can be attained normally only by achieving some approximate degree of correctness in each of many complex relations. Business recessions on the other hand might be due to one cause (e.g., 1914), but are more commonly due to a complex of many causes. Business recessions may even differ among themselves in the type of cause chiefly important. In 1929 an unsound level of security prices, in 1937 an overrapid advance of certain wage rates played important rôles.

All major recessions, by whatever cause initiated, tend to follow a somewhat similar pattern. A collapse of security prices, for example, would induce or compel many consumers to use income for debt reduction instead of further purchases. Reduction of sales volume may then induce producers to liquidate inventories and thus to reduce income payments in even greater ratio. Construction of new facilities would also be curtailed. Consumers whose incomes are now reduced cannot continue to buy the former volume of goods at former prices. Prices and costs cannot, however, be readjusted instantly. Unemployment and idle plant capacity become, therefore, general.

The seriousness of the depression that follows is affected by the seriousness of the initiating mishap, by the relative favorableness or unfavorableness of the other conditions then present, and also by the flexibility of the business mechanism. Horizontal combinations tend in general to develop a rigid price structure. Recent experience suggests that increases in the influence wielded by trade associations and cartels may tend to increase the rigidity of many prices and thus operate to increase both the depth and the duration of business depression. German experience suggests (though this is not orthodox theory) that extreme cartelization with its rigid prices may even lead to political despotism because despotism may then become less intolerable than the results of nominally free contract. Orthodox theory says only that the seriousness and length of any business depression may be increased by inflexible prices and by any condition unfavorable to investment confidence.

Returning now to Mr. Scherman's final chapters, we find that his theory of the business cycle may well be summarized (p. 424) as follows: "We can isolate in our imagination a sample enterprise in each one of these large fields of human activity, and see how the actual or feared incompletion of economic promises decreases its own total volume of exchanges. At the same time, we can watch how it does something else: How it decreases the number of exchanges entered into by all the enterprises which deal with it, and all the individuals engaged in it." Mr. Scherman's emphasis on credit is not incorrect; to this reviewer his position seems merely incomplete and a generation out of date. Incompletion of promises is now viewed as one symptom of a disease rather than the cause of a malady. Modern students consider the difficulty more deeply seated.

Debt and the redemption of promises do, of course, play an important rôle in the business cycle; but our alternative volume[2] promptly grants clear recognition to the limitation of the rôle played by promises. The Twentieth Century Fund study states (p. 7) "In short, if the history of the years before 1929 is evidence, major debt difficulties can leave prosperity unshaken so long as other conditions are not unfavorable." Later (p. 8) it states ". . . the collapse of debts was one of the chief sources of fear; and fear is of all things the most disrupting . . ." Fear, however, may be caused by other influences and to these other influences is assigned regularly their true importance. Though the subject of this book also is debt, it is debt seen in correct perspective.

The Twentieth Century Fund study is divided into two parts: 241 pages are devoted to an examination of the facts, then 27 pages are devoted to recommendations. Because it is hoped that both the detailed facts and this committee's program may be reviewed on this page in some future issue, only one summary will be presented now and this one partly to suggest the more painstaking method by which the problem is here approached. From a variety of sources a new total of American debt has been compiled. In 1929 this total was in excess of 250 billion dollars. In 1937 the total was again approximately 250 billion dollars.

The character of American debt has, however, been altered. Debt of two kinds has been notably reduced. Real-estate mortgage debt (urban and rural) has diminished from 40 to 35 billion dollars and the short-term debt receivable at banks and corporations fell from 53 to 30 billions. Three types of debt are, however, close to their 1929 totals. Commercial banks now owe 46 billion instead of 47, mutual savings banks owe 10 billion instead of 9, and building-loan associations owe 4 billion instead of 5. The net change in those debts which are called deposits is therefore small; but debt of three types has been increased. The bonded debt of corporations has risen from 47 billion to 50 billion; tax-exempt securities have been increased from 32 to 53 billion (nearly 67 per cent) and the obligations of life-insurance companies to their policy holders have risen from 12 to 20 billion dollars.

Greater interest attaches, however, to the steps by which these new totals have been reached. The net debts of state and local governments rose steadily from 1919 to 1929, then more rapidly until 1933, since which date they have apparently diminished. The variations in commercial bank deposits have been more dramatic. Excluding interbank debt, these fell from 43 billions (1929) to 25 billions (1933); then rose to 41 billions (1937).

In the steps by which such changes occurred may be read the story of business recovery up to 1937. Occasionally (but not always) an important cause of other changes, these changes record with considerable fidelity the progress of recovery. As an instrument for analysis debts possess therefore an importance quite apart from their significance as a financial burden. It is by the use of this instrument that this book makes its contribution. It is because of the facts thus discovered that recommendations are made. One of its suggestions (corporate stocks a legal investment for savings banks) is radical, yet so closely reasoned is the preliminary analysis that thoughtful people everywhere will be both interested and impressed. New public policy may therefore grow out of this more thoughtful study.

[2] "Debts and Recovery." Published by the Twentieth Century Fund, New York, N. Y., 1938.

PROFESSIONAL RECOGNITION

Summary of a Study for the E.C.P.D. of the Qualification Procedure in the Fields of Accounting, Architecture, Law, and Medicine

THE PURPOSE of this study is to determine and analyze the current methods of granting recognition to candidates in the several professions, law, medicine, architecture, and accounting. The study embraces all of the United States and includes where possible the history and development of the process of accrediting candidates in the various professions. The process of accrediting in a profession is interpreted to include:

a Admission to practice in a profession under the state laws
b Admission to full membership in the professional society.

The preceding statement, written as a guide at the inception of this study, serves at this point to introduce a summary of the report. The complete report consists of four sections, each of which deals with one of the professions studied. Each of these sections gives considerable background material on the development of the profession, its educational facilities and professional societies, and the controls in the admission to these. It is the objective of the summary to assemble the salient features of the study for correlation and comparison with some features of similar character in engineering. Reference should be made to the ***individual sections*** of the complete report for details and references.

The groups composing each of these professions (Table 1) are defined with varying degrees of clarity. Those constituting the medical and legal professions are easily designated, inasmuch as they are required by state law to register before they practice. However, a large number of individuals who are prepared for practice in accounting, architecture, or engineering frequently seek no formal recognition of their practice, or apply their training in nonprofessional activities.

The figures given in Table 2 are not directly comparable. Of the 5000 individuals graduating from schools of medicine, very close to 100 per cent apply for admission to practice and over 98 per cent of these are successful in securing admission. The number who have sought admission to law practice via the bar examinations is double the number of successful applicants. Many of the unsuccessful applicants retake the examinations, so that eventually over 90 per cent of an original group of applicants succeeds in securing admission. However, a considerable number never succeed in formal admission to practice. Individuals trained in accounting and engineering enter a wide variety of professional and nonprofessional activities.

WHAT IS CONSIDERED BY THE PROFESSION AS CONSTITUTING ADMISSION?

Recognition of admission to practice in a profession by the profession itself and by the state may be identical or may widely differ. In medicine, admission to practice is universally recognized to be by examination under the direction of the various state boards. The passing of these examinations, the registration by appropriate local authorities, and the holding of the degree, M.D., are the minimum qualifications generally expected of a practitioner in medicine. A glaring variance from these high professional requirements exists in that large number of sectarian practitioners of the healing arts who meet no standards except those set for them by their cult leaders and followers. At the other end of the scale appears the requirement of demonstrated proficiency of those who wish to designate themselves practitioners of "medical specialties." As yet given cognizance mainly by the members of the profession, legal and general recognition of these specific requirements will undoubtedly follow.

Professional recognition of lawyers comes universally with their "admission to the bar," a process governed by the state boards in their administration of the "bar examinations."

Of the many people practicing or making use of accounting, only those qualified by the states to call themselves "certified public accountants" may do so. General recognition of the architect is given to those practitioners who have been admitted to practice by the state boards (in 38 states) and who are therefore "registered architects." It must be noted, however, that there are many nonregistered accountants and architects who carry on considerable recognized professional work as individuals or as members of firms. However, particular privileges are given by the state and the professions to those recognized by the state in so far as only a "certified public accountant" may certify various forms of financial statements, and only a "registered architect" may sign plans for constructions involving public health and safety.

A great deal of the work undertaken by the engineers has been done without formal recognition of the practitioner by the state. Recognition of an individual as an engineer by the profession generally has come through an appreciation of the engineering work that he does. Beyond this, membership in a senior grade of one of the national engineering societies has also been a criterion for evaluation.

LEGAL ADMISSION TO PRACTICE

Certified Public Accountant.

All of the states now have laws which limit the use of the term "certified public accountant" to accountants upon whom this designation has been conferred by a state board as a result of examination or after compliance with certain requirements. In only a few instances have states as yet prohibited the practice of accounting by persons not holding the certificate or not registered.

Following a practice of many years, expanded recently, the boards of examiners in 40 states and 4 territories employ examinations written by the American Institute of Accountants and rated for the individual boards by the Institute. Individual examinations, generally of high quality, are given in Kentucky, Maryland, New Jersey, New York, Ohio, Pennsylvania, Virginia, and Wisconsin.

Forty six of the states and all the territories require, before admission to examination, evidence of high-school education or equivalent. Only New York has gone beyond this and now requires the completion of a specified course of study in an approved school of accounting. All but three require some, and

Summary only of report bearing this title, by A. Dexter Hinckley, prepared for the Committee on Professional Recognition of the Engineers' Council for Professional Development, and presented at the Sixth Annual Meeting, October 21–22, 1938.

TABLE 1 SIZE OF PROFESSIONAL GROUP

	Accounting	Architecture	Engineering	Law	Medicine
U. S. Census, 1930	200,000	22,000	226,249	160,605	153,803
Qualification	"accountants and auditors"	"architects"	"technical engineers and surveyors"	"lawyers, judges, etc."	"physicians"
Population per practitioner	610	5600	543	765	800
Best estimate (year)	17,000 (1937)	12,900 (1936)	173,151 (1935)	200,000 (1938)	165,000 (1938)
Source of figures	Individuals licensed to practice in one or more states	Individuals licensed to practice in 39 jurisdictions where law exists	Unduplicated file used in survey of engineering profession	Assuming net annual gain of 5000	Assuming net annual gain of 1700
Other estimates	30,000 (1935)	13,000 individuals or members of firms. 40,000 more employed by them	....	175,000	156,440 (1931) American Medical Directory. In addition (1932) sectarian practitioners of the healing art, 35,000

TABLE 2 NUMBERS ANNUALLY QUALIFIED FOR ADMISSION TO PROFESSIONS

	Accounting	Architecture	Engineering	Law	Medicine
Number	?	600	9000	9000	5000
Source of figures	....	Graduates from schools of architecture	Graduates with first degree from schools	Admissions to bar in the states, by examination or on diploma	Graduates of medical schools

TABLE 3 PROFESSIONAL SOCIETIES

	National				
	American Institute of Accountants	American Institute of Architects	Four Founder Engineering Societies	American Bar Association	American Medical Association
Founded	1916	1857	..	1878	1846
Total membership	5000 (1937)	2970 (1936)	43,986 (1934-35)	27,178 (1936)	98,000 (1936)
Per cent of profession	29	23	20	14	60
	Local and State				
	State associations	Numerous local, state, city, and county associations	80 national, 42 state, 197 local	Local and state, 1430 total (1934) 468 active	Numerous local, state, county, and functional associations
Per cent of profession	50	....	....	60% in active associations	....

a majority of the states require at least three years of acceptable experience as another preliminary qualification. Credit toward the experience requirement for technical education (beyond high-school level) is given, in about one third of the states.

Registered Architect.

Thirty-eight states and the District of Columbia have compulsory laws—"a person is prohibited from practicing architecture without being registered," or "a person is prohibited from representing himself to be an architect without being registered." Registration under these laws can be made under the "junior class" or "senior class." To be considered for admission to the junior class it is generally required of applicants that they present evidence of a certain term of experience. Preliminary educational requirements are likewise set and these also range widely from no requirement to graduation from a college of architecture. If the applicant submits satisfactory preliminary credentials, there is usually the further requirement of an examination or an exhibition of certain specimens of the applicant's professional work or both. Partial or complete exemption from the "experience" requirement or the examination, or both, is often granted to those applicants who have completed a course of study in an "approved" college of architecture. Applicants for admission under the "senior class" must, in a majority of states, present evidence of ten years' satisfactory experience as a "principal."

Member of the Bar.

In every state the courts and legislatures have delegated to a board of examiners the responsibility of examining applicants for admission to the bar. Thirty-six states have set as a preliminary requirement a period of general college education of at least two years; eleven of the remainder require high-school education. Forty states require a minimum of three years of legal training, six states require a minimum of two years. Many states make a requirement as to the schools in which legal training may be pursued; there are now sixteen states where, for all practical purposes law-school study will not be recognized unless pursued in a school maintaining the standards and on the "approved" list of the American Bar Association; seven more give decided preference to students in such schools.

Physician.

Since 1925, admission to practice in all states and all territories is by examination under state boards of examiners. There is a widespread uniformity in the preliminary requirements for admission to examination. Forty states and the District of Columbia require two years of college training, previous to medical school. Of the remaining eight, three require one year of college training. All states require that applicants be medical-school graduates and 46 insist upon graduation from an approved medical school; 17 states and two territories require interneship before formal admission to practice.

QUALIFICATIONS FOR AND CHARACTERISTICS OF MEMBERSHIP IN PROFESSIONAL SOCIETIES

American Institute of Accountants.

For admission to grade of member or associate in the Institute, age and general education (high school) requirements must be satisfied. Qualification for member grade requires that the applicants have been for five years in public practice, or in accountancy instruction, satisfactory as to quality and continuity. Similar requirements for associate grade consist of two years of practice or three years of instruction. The major requirement for admission as member now is that the applicant must be a holder of a valid C.P.A. certificate from one of the states or territories.

The present members of the Institute are almost 100 per cent "certified public accountants." Although there was no change in Institute requirement in 1926 the additions to Institute membership were distinctly better following that date. For comparable groups in other respects, we note an increase in the proportion of college graduates from 20.5 to 32.4 per cent.

There are many strong local and state associations of certified public accountants, whose standards of membership in some instances come up to those of the American Institute.

American Institute of Architects.

Membership in the Institute is of three grades, "fellow," "member," and "associate" (or "junior associate"). Membership in the Institute may be secured by any architect who can present proof of his professional and personal qualifications. For member grade, exhibits of executed work are usually not required if the applicant is a graduate of an "approved" school and has had at least two years as a practicing architect. Nongraduates must present exhibits of executed work and must have had a minimum of three years of independent practice. An architect who has made notable contributions to the profession and who has been a member for ten years is eligible for election as a fellow. Membership in the junior grades is open to any architect or architectural draftsman or student who is approved by the local chapter of the Institute.

It has been estimated that over 90 per cent of the members of the Institute are licensed to practice in their state. It has also been estimated that over 60 per cent of the Institute's membership are graduates of "approved" architectural schools.

There are numerous independent associations, local, city, county, and state, some of which are individually quite active and influential in the profession.

American Bar Association.

The qualifications for membership, as stated in article II of the constitution are:

"Any person who is a member in good standing of the bar of any state, shall be eligible to membership in this Association, on nomination in accordance with provisions of article III." As this stipulation for membership can be met by practically every lawyer in the country no great store can be set in such membership. There are many local and state bar associations and many of these have set qualifications for admission more severe than the liberal democratic stipulation of the national association.

American Medical Association.

Membership in the American Medical Association is open to any reputable practitioner in the country. As in the case of the American Bar Association, this single stipulation makes the whole profession eligible for membership.

Since about 35 per cent of recent graduates limit their work to a medical specialty, training in each of the twelve special fields and membership in the appropriate functional society become the prime measure of professional standing.

Definition of the qualifications for candidates who wish to be admitted to the examinations of the various boards of medical specialties has been set as follows by the Advisory Board of Medical Specialties:

Applicants should present evidence of:

Satisfactory moral and ethical standing in the profession

Membership in the American Medical Association, or by courtesy, in such Canadian or other medical societies as are recognized for this purpose by the Council on Medical Education and Hospitals

Graduation from a medical school in the United States or Canada recognized by the Council

Completion of an interneship of not less than one year in a hospital approved by the Council.

In addition to these general requirements the Board adopted the following requirements for special training, to be effective in so far as practical not later than Jan. 1, 1938:

A period of study after the interneship of not less than three years in clinics, dispensaries, hospitals, or laboratories recognized by the Council

This specialized preparation should include: Intensive graduate work in the basic medical sciences necessary to the proper understanding of the particular specialty; an active experience of not less than eighteen months in approved hospital clinics, dispensaries, and diagnostic laboratories, examinations in the medical sciences basic to the specialty as well as in the clinical laboratory, and public health aspects of the subject

An additional period of not less than two years of study, practice, or a combination of both.

The American College of Physicians and the American College of Surgeons have for 25 years given distinction to their respective memberships by their election for pre-eminence in the fields of internal medicine and surgery, respectively. Election is based upon evidence of specified accomplishments in the specialized fields.

DISTINCTIVE FEATURES OF THE PROFESSIONS—POINTS OF LIKENESS AND DISSIMILARITY

We find each of the professions herein studied in a state of flux and growth. Similar in that respect, they differ largely as to the distance they have gone on the path of professional development. Each profession goes through the same stages of development and each suffers in exactly the same way.

In each of the professions the process of preparation for practice has been removed from the apprenticeship to the technical school. In each, the body of practitioners, through the professional association, finds inadequacies in the preparation offered to prospective practitioners. Through the associations, the professional schools are surveyed, standards are set, some schools accredited, some not. In order of development we note the present progress in this direction in Table 4.

In each profession there is a broadening of the conception of the profession and with this the demand comes for a broadening of preparation. Thus there is an increase of general college

TABLE 4

	Approved		Unapproved	
	Schools	Per cent of total attendance	Schools	Per cent of total attendance
Medicine	74	95 (approx)	3	5
Architecture	30	80 (approx)	22	20
Law	97	61.2	88	38.8
Engineering	445[a]	?	181[a]	?

Accounting: No general accrediting procedure for the some 500 colleges giving accounting, although New York State is now accrediting schools.

[a] Curricula.

training, and the requirements of this, written or implied, have been increasing in medicine, law, and architecture very rapidly.

In each of the professions, forces are at work attempting to raise the standards of preparation and the methods of admission to the profession. The "sections" of the national professional associations, together with the national conferences of boards of examiners, have made real progress in this direction. It is generally these organizations, in cooperation with the associations of professional schools, which raise the professions' standards as to general and technical education.

One of the points on which the professions differ considerably is on the significance of the academic degree received at the end of the formal professional training. The traditional degree received in the medical profession is the M.D. and this is the only one carrying professional significance. Practically all the university law schools use the L.L.B., or under certain circumstances the J.D. In architecture there are numerous terminal degrees including Master of Architecture, Master of Arts in Architecture, Bachelor of Fine Arts, Bachelor of Architecture, Bachelor of Science in or of Architecture, etc. No professional degree is given in accounting except as it be granted by a university school of business giving a baccalaureate course. In engineering a great variety of degrees exists, revolving primarily around the Bachelor of Science in a particular department of engineering.

With the increasing complexity of professional work and the increasing evidence of insufficient or misdirected technical schooling, we note the professions undertaking greater amounts of postgraduate training. In medicine there are the courses for medical specialists—special clinics, interneships, residencies, conferences, and short courses, organized by the practitioner associations and hospitals. In engineering, a great many graduates have for years carried forward specialized studies, and the lawyers are now developing such activities through their legal institutes, and special conferences at the law-association meetings.

Probably the greatest problem for the professions is of equal importance to all of them. That problem has several angles:

1 Getting the properly qualified individuals into the profession.

2 Measuring the qualifications of the applicants.

This problem must be faced by professions which are changing in formation and perhaps in character. Accountants, architects, and lawyers find their status as individual practitioners disappearing. Unlike the physician, firms of accountants, architectural firms, and law firms are on the increase. The engineer has long since lost his individuality as a practitioner and functions now almost exclusively as a member of an organization. It is interesting to note the common thread of thought on the broadening of professional practice, as expressed in the following characteristic quotation:

"The accountant must therefore cooperate with the legal profession in the drafting of laws pertaining to financial structures—should become an economist and an industrial engineer—should take a leading part in local, state, and federal business." "Young men believe all they have to do is to study a little, grasp the fundamentals of bookkeeping, and blossom forth as accountants. They overlook the essential qualifications of analytical ability, integrity, personality, and refinement."

Like expressions have come from each of the professions, urging that the membership of the profession increase the quality, moral character, integrity, and other personal qualifications of its applicants. It is also generally urged that they take part in the study and solution of social, economic, and political problems.

It is most apparent from the expressions of thought in each profession that an unsatisfactory job is being done on the selection and admission of new practitioners. Admission to the bar requires the hurdling of one major barrier—the bar examination. Calculated to assay applicants with widely varying backgrounds and training, it ultimately passes over 90 per cent of all applicants into the profession. On first trial it is customary for less than 20 per cent of those attempting the American Institute of Accountants' examinations to pass. After numerous appearances somewhat over 50 per cent finally do pass the examinations.

In medicine, the largest part of the weeding-out process is done during the years of preprofessional training, and actually but 50 per cent of all applicants are accepted into the medical schools. Coming then almost universally through "approved" medical schools, the graduates experience no difficulty with the examination set up by the state. A similar adequacy of training, college and practical, serves to prepare architects for their formal admission to practice.

We see therefore a partially successful solution of the major problem—the extension of training, with more exposure to the character building influences of the undergraduate college—practiced most successfully by the professions of medicine and architecture. Quantitative measures cannot be made of the success of the solution of this problem but the example will undoubtedly be followed by law, engineering, accounting, and other professions.

"PENNSYLVANIA FENCE"
(Photographed by O. F. Zahn, Jr., shown at Photographic Exhibit of 1938 A.S.M.E. Annual Meeting.)

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to original sources is given.

Diesel Rail-Car Control

THE INSTITUTION OF MECHANICAL ENGINEERS (GREAT BRITAIN)

A REVIEW of the present state of development of Diesel rail-car control and transmission is contained in a paper by W. G. Wilson entitled "The Control of Diesel Railcars, With Particular Reference to Transmissions," read on Nov. 18, 1938, at a meeting of The Institution of Mechanical Engineers (Great Britain).

According to Major Wilson, the control of a Diesel-driven train can be said to consist of the following operations: (1) Starting it with smoothness and with the greatest possible acceleration; (2) driving it at the speed required, such speed being obtained with the greatest possible economy; and (3) stopping it in the shortest time, and with the least discomfort to the passengers.

The questions of stopping, which is common to all forms of rail traction, and of engine-throttle control, except where this is associated with the transmission system, were not dealt with to any great extent in Major Wilson's paper.

The ideal form of transmission and control for a Diesel rail car, according to Major Wilson, has the following attributes: (1) It is simple to maintain and reliable in service; (2) it is easy to control and cannot cause damage by mishandling; (3) it is silent and efficient; (4) it is light in weight, yet robust; (5) it allows the engine to work at its most economical speed under any conditions; and (6) it does not hamper the construction of the car by necessitating a special disposition of the engine in relation to the driving axles.

As no one has produced any system which fulfills every requirement of this ideal specification, it is necessary to sacrifice one or more of these conditions in order to fufill others.

A glance at the control desks of the different types of rail car, said Major Wilson, will show where the similarities lie. All aim at the minimum of levers, gages, buttons, and the like, to distract the driver's attention. All have throttle, brake, and forward and reverse controls, oil-pressure gage, air-pressure gage, and either a speedometer or revolution counter or both. A gear-changing mechanism with or without clutch control is also necessary with mechanical transmissions, and a direct-drive control with hydraulic transmission.

Two important considerations from the point of view of coach layout and construction are, in Major Wilson's opinion, the size and position of the engine and the number of wheels any engine can be made to drive. It was convenient therefore to divide transmission systems into two main classes: (1) Indirect drives, which do not require any particular disposition of the engine with respect to the driving wheels (e.g., electrical); and (2) direct drives, which depend on a transfer of torque from one shaft to another by any means, whether mechanical or hydraulic or both, that necessitates a special position of the engine. The latter class covers a large field, but though it has been the custom in the past to draw a rigid line between mechanical and hydraulic transmission, it now seems that the wide use of mechanical change-speed gearboxes in conjunction with hydraulic couplings has lessened the gap between them, particularly when it is considered that in certain forms of hydraulic torque converter the direct drive is by means of the mechanical clutch.

The direct drives were therefore subdivided by Major Wilson into mechanical and hydromechanical transmissions, and the latter are again subdivided into those using mechanical torque conversion and those using hydraulic torque conversion. Certain designs of mechanical change-speed gears, he said, are particularly suitable for use with hydraulic couplings; these are mainly of the epicyclic type. It is, however, possible to use a hydraulic coupling with various kinds of gearboxes in just the same way that the epicyclic gearboxes, which are associated with the hydraulic coupling, can be used with other types of clutch.

In his consideration of electric transmission (indirect drive) Major Wilson described the Brown Boveri-Sulzer system, the Frichs system, and the English electric torque-control system. Of the mechanical systems (direct drive) he described the Wilson gearbox, the Mylius gearbox, the S.L.M. gearbox, the Ganz transmission, and the Cotal gear. Of the hydromechanical types with mechanical torque conversion, mention was made of the Vulcan-Sinclair; and of those of this type with hydraulic torque conversion the examples used were the Lysholm-Smith and the Voith-Sinclair.

Concluding the paper Major Smith posed the following question: Will development be toward simplifying the controls by evolving mechanism which will insure that changes of gear, or their equivalent, take place at the right time, and which will automatically stop the engine and save it from damage should the oil pressure fail, or is the driver, in addition to his responsibility for driving the train and observing signals and speed restrictions, to be entrusted with the duties of engineer in charge of a delicate piece of machinery?

New American Pipe Standard

AMERICAN STANDARDS ASSOCIATION

UNTIL comparatively recently commercial requirements for wrought-iron and wrought-steel pipe were fairly well met by the three schedules known as standard weight, extra strong, and double-extra strong. Since about 1920, however, when steam pressures and temperatures started to climb above 250 psi gage and 600 F, which had been tops for the preceding two decades, and when the diversifications of new process work such as the oil and gas industries demanded a greater variety of wall thicknesses and diameters, there was a tendency to order a greater variety of wall thicknesses not included in the three schedules. Soon it became apparent that it was necessary to restrict the choice of wall thickness to a reasonable number of standard schedules which would adequately cover the field in

a consistent manner without trying to provide hair-line differences in thickness.

Hence in March, 1927, the American Standards Association authorized the organization of Sectional Committee B36 on Standardization of Dimensions and Material of Wrought-Iron and Wrought-Steel Pipe and Tubing. The A.S.M.E. and A.S.T.M. were designated as joint sponsors. Chairman and secretary, respectively, of the committee are H. H. Morgan and Sabin Crocker, members A.S.M.E. The committee developed the American Tentative Standard B36.10 which is now up for advancement to full American Standard. From information supplied by Mr. Crocker, the following review of the standard was prepared.

Table 2 of A.S.A. B36.10 giving the dimensions of welded and seamless steel pipe is reproduced here as Table 1. The standard contains a similar table for schedules 10, to 80, inclusive, of wrought-iron pipe, and corresponding tables of weight for both products.

The A.S.A. B36.10 standard for wrought-iron and wrought-steel pipe consists of ten weight and thickness schedules for these materials, of which the lightest wall is schedule 10 and the heaviest schedule 160, although schedule 80 is the heaviest wall so far contemplated for wrought iron. Tabular wall thicknesses were worked out by a basic formula intended for this purpose only and not to be confused with design formulas such as found in the A.S.M.E. Boiler Code and the A.S.A. Code for Pressure Piping. The nature of the basic formula and the method of using it are described in the preface to the B36.10-1935 Tentative Standard. Tabular values of weights for corresponding sizes of steel and wrought-iron pipe are identical in sizes up to and including 12 in., although the nominal wall thicknesses for the two materials have been adjusted slightly to compensate for the small difference in specific weights. If the weights per foot of pipe of the two materials are given as the same, the wall thickness of wrought-iron pipe must necessarily exceed those for steel by about two per cent. In sizes 14 in. OD and larger where the thicknesses are the same, the necessary adjustment has been made in the weights.

Schedule numbers represent approximate values of the expression 1000 P/S, where P is pressure in psi and S is the maximum bursting or hoop stress which the material is capable of sustaining with a reasonable factor of safety. For example,

TABLE 1 DIMENSIONS OF WELDED AND SEAMLESS STEEL PIPE

Nominal Pipe Size	Outside Diam.	Nominal Wall Thicknesses for Schedule Numbers									
		Sched. 10	Sched. 20	Sched. 30	Sched. 40	Sched. 60	Sched. 80	Sched. 100	Sched. 120	Sched. 140	Sched. 160
1/8	0.405	......	......	......	**0.068**	......	**0.095**	......	......	......	......
1/4	0.540	......	......	......	**0.088**	......	**0.119**	......	......	......	......
3/8	0.675	......	......	......	**0.091**	......	**0.126**	......	......	......	......
1/2	0.840	......	......	......	**0.109**	......	**0.147**	......	......	......	0.187
3/4	1.050	......	......	......	**0.113**	......	**0.154**	......	......	......	0.218
1	1.315	......	......	......	**0.133**	......	**0.179**	......	......	......	0.250
1 1/4	1.660	......	......	......	**0.140**	......	**0.191**	......	......	......	0.250
1 1/2	1.900	......	......	......	**0.145**	......	**0.200**	......	......	......	0.281
2	2.375	......	......	......	**0.154**	......	**0.218**	......	......	......	0.343
2 1/2	2.875	......	......	......	**0.203**	......	**0.276**	......	......	......	0.375
3	3.5	......	......	......	**0.216**	......	**0.300**	......	......	......	0.437
3 1/2	4.0	......	......	......	**0.226**	......	**0.318**	......	......	......	......
4	4.5	......	......	......	**0.237**	......	**0.337**	......	0.437	......	0.531
5	5.563	......	......	......	**0.258**	......	**0.375**	......	0.500	......	0.625
6	6.625	......	......	......	**0.280**	......	**0.432**	......	0.562	......	0.718
8	8.625	......	0.250	**0.277**	**0.322**	0.406	**0.500**	0.593	0.718	0.812	0.906
10	10.75	......	0.250	**0.307**	**0.365**	**0.500**	0.593	0.718	0.843	1.000	1.125
12	12.75	......	0.250	**0.330**	0.406	0.562	0.687	0.843	1.000	1.125	1.312
14 O.D.	14.0	0.250	0.312	0.375	0.437	0.593	0.750	0.937	1.062	1.250	1.406
16 O.D.	16.0	0.250	0.312	0.375	0.500	0.656	0.843	1.031	1.218	1.437	1.562
18 O.D.	18.0	0.250	0.312	0.437	0.562	0.718	0.937	1.156	1.343	1.562	1.750
20 O.D.	20.0	0.250	0.375	0.500	0.593	0.812	1.031	1.250	1.500	1.750	1.937
24 O.D.	24.0	0.250	0.375	0.562	0.687	0.937	1.218	1.500	1.750	2.062	2.312
30 O.D.	30.0	0.312	0.500	0.625	......	......	......	......	......	......	......

All dimensions are given in inches.

Thicknesses shown in bold face type in Schedules 30 and 40 are identical with thicknesses for "standard weight" pipe in former lists; those in Schedules 60 and 80 are identical with thicknesses for "extra strong" pipe in former lists.

The Schedule Numbers indicate approximate values of the expression 1000 × P/S.

The decimal thicknesses listed for the respective pipe sizes represent their nominal or average wall dimensions. For tolerances on wall thicknesses, see appropriate material specification.

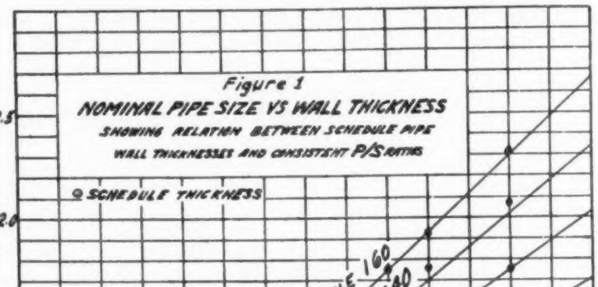


FIG. 1 NOMINAL PIPE SIZE VS. WALL THICKNESS

schedule 40 seamless pipe of mild steel having an allowable working (bursting) stress of 10,000 psi at around 700 F should be good for just about 400 lb steam pressure at that temperature, as demonstrated by

$$\text{Schedule number} = (1000 \times 400) \div 10{,}000 = 40$$

In the same schedule 40, wall thicknesses of other materials and steam temperatures would, of course, have different allowable bursting stresses and hence be good for different working pressures. The foregoing relation does, however, give an approximate rule of thumb for visualizing the physical significance of the schedule numbers in easily understood terms. In a very rough way the allowable working pressure often comes out about ten times the schedule number except where creep is a predominant factor. This is because of the fact that at temperatures up to 750 F, the allowable stress for carbon steels averages about 10,000 psi. On the other hand, provision for new materials and more severe service conditions than contemplated, even at present, are provided for in that the thicknesses are not tied to particular pressure-temperature conditions or materials as was the case with the old series of thicknesses first published in connection with ASTM Specification A106-26T.

Designers wishing to compute the proper thickness of pipe for a given service application should use the design formulas provided in the A.S.A. Code for Pressure Piping or the A.S.M.E. Boiler Construction Code as the case may be. These formulas give the minimum pipe-wall thickness required on inspection. It is trade practice, however, to furnish pipe to nominal or average wall thicknesses with a plus and minus tolerance to look after variations in manufacture. In ordering pipe, therefore, a nominal wall should be selected from the B36.10 tables which, after deducting for mill tolerance as defined in the specification under which the pipe is bought, is just sufficient to afford the minimum thickness on inspection as computed by the design formula. Procurement of pipe will be facilitated through buying under a standard specification covering properties of the material and including manufacturing tolerances.

Fortunately, the old standard-weight and extra-strong thick-

nesses coincided rather closely with the new schedules 40 and 80, respectively, as shown in Table 1 where thicknesses common to both systems are set in bold-face type. This constitutes a definite advantage since the use of these old weights is so firmly intrenched in the plumbing and heating trade that any plan which did not embrace them at least through a transition period, would not be generally acceptable. The fact that a few old thicknesses are split between adjoining columns arises from the lack of consistent progression of thickness with increasing pipe size under the old system, as well as to the fact that previous to 1927 there were alternate thicknesses of standard-weight pipe in the 8-, 10-, and 12-inch sizes. Besides being thicker than schedule 160 pipe which is the heaviest now contemplated in the standard, the old double-extra-strong schedule was so erratic as to have no place in the new system and accordingly its thicknesses were dropped from consideration.

Examination of Table 1 shows that whereas all schedules cover the large sizes up to 24- or 30-inch diameter, only schedules 40, 80, 120, and 160 extend below the 8-inch size, and of these only 40, 80, and 160 have sizes below 4 in. That there is good reason for this is apparent from Fig. 1 where the schedules are portrayed graphically in fan-shaped formation diverging from an origin of small diameter and light wall thickness. The close proximity of the lines representing schedules 40, 80, 120, and 160 from near the origin out to sizes of the order of 4- to 8-inch diameter demonstrates the reason for omitting the intervening schedules within this range as unnecessary because of the very small differences in thickness which are involved.

It is the aim of Sectional Committee B36 and the purpose of this article to bring the new system of schedule numbers to the attention of the piping designers in general in such a manner as to expedite universal use of the B36.10 standard through familiarizing all concerned with its advantages over the old setup. With this end in view it is hoped that those responsible for ordering pipe will initiate the practice of specifying what they want by diameter and schedule number so as to effect the gradual change-over desired.

Noise Reduction in Ships

INSTITUTE OF MARINE ENGINEERS (GREAT BRITAIN)

WITH THE coming of the motorship, marine engineers have spent much time on the problem of reducing the vibration of the oil-engine machinery. Greater attention is now being paid to the diminution of the noise set up by machinery and other disturbing factors, according to R. S. Robinson, who has made a prolonged study of the subject, and who described the incidence of noise and its control on board ship in a paper entitled "Experiments in Noise Reduction in Ships," which he read before the Institute of Marine Engineers (Great Britain) on Nov. 8, 1938.

Unfortunately, the structure of a ship represents an efficient medium for the transmission of sound throughout its bulk, and there are many sources of sound. Mr. Robinson pointed out that in the internal-combustion engines used in motorships, higher maximum combustion pressures are now employed. Coupled with this we have lighter installations of greater horsepower and increased speeds of auxiliary equipment, such as Diesel-driven generators. Offsetting these to some extent are mechanical improvements in valve gear and more efficient silencing.

After describing the nature of sound and methods of its measurement, Mr. Robinson discussed different materials in relation to their power of absorbing sound. Broadly speaking, hard materials such as steel, concrete, and plaster have practically no sound-absorbing capacity—in fact they are efficient reflectors of sound. On the other hand, soft fibrous materials such as felts, cushions, and carpets are good sound absorbers. Soundproofing passenger accommodation in ships largely depends on design and intelligent use of materials having diverse properties. For cabins, for instance, acoustic ceilings and luxury (soft) furnishings help considerably.

All sound is, of course, the result of vibration, and reduction of vibration of an engine should concurrently reduce the noise it gives out. Antivibration mountings are common enough in land practice and have frequently been applied on shipboard, but the problem of flexibly mounting the main propelling machinery is one of great practical difficulty, particularly with large engines. It is not sufficient only to fix a machine on springs, rubber, or some other resilient material between the bedplate and the foundation. The general principle is to produce a mounting such that its natural period of vibration is considerably lower than the frequency of any disturbance arising in the machine itself. At the same time, with regard to the effect upon the general noise, in some cases Mr. Robinson had not been able to find a difference in structural sound attenuation between vessels with and without isolated mountings.

Mr. Robinson went on to consider methods adopted for insulating the engine room from the rest of a ship by covering walls and decks with soundproof and fireproof materials. Asbestos, magnesia, and cork are among the most important materials used for sound reduction. It is evident from the paper that there is much room for further research and practice in the prevention and reduction of noise in ships.

Nylon

INDUSTRIAL BULLETIN OF ARTHUR D. LITTLE, INC.

A CONVENIENT summary of pertinent information on the new synthetic fiber nylon appears in the ***Industrial Bulletin*** of Arthur D. Little, Inc., for November, 1938. The following is quoted from the bulletin: The name "nylon" has been coined to designate generically "the synthetic fiber-forming polymeric amides having a protein-like structure from which the new product is formed." The Carothers patents state that these polyamides can be produced by reacting diamines and dibasic carboxylic acids. Emphasis is placed on the strictly synthetic origin of the new fiber as basically from coal, air, and water, although raw materials for actual fiber manufacture are chemical intermediates commercially available at present in small quantities.

An important step in the manufacture of the fiber is the cold drawing of the wet filament. As initially formed the polyamide fibers are weak, and show an X-ray diffraction pattern characteristic of crystalline rather than fibrous materials. After coagulation, stretching from 200 to 700 per cent of the original length produces a permanent increase in length and is accompanied by a change in the X-ray pattern to that of a true fiber of high wet and dry strength and unusual elasticity. Filaments of extreme fineness can be spun much finer than those of rayon or natural silk. Nylon can also be formed into sheets or coarse fibers. The first nylon product to reach commercial use is the bristle fiber "exton," in a recently announced toothbrush.

Chemically, nylon resembles natural silk, both being polyamides of protein-like structure. Dyeing is said to present no particular difficulties, and in general nylon takes dyes for silk, wool, and acetate, and some direct dyes for cotton or rayon.

One of the most promising uses suggested for nylon is high-

twist yarn for fine hosiery. It is claimed that hosiery made of this yarn possesses extreme sheerness, great elasticity, high strength, and improved resistance to runs. Natural silk has always held a dominant position in this field and the announcement of the new fiber may be a matter of great concern to the natural-silk industry. The experimental work back of the development is said to cover the better part of a decade, culminating in a pilot plant that has been operating near Wilmington during the last few months producing small quantities of nylon yarn and exton toothbrush bristles.

Du Pont now announces the appropriation of $8,000,000 for the construction, near Seaford, Delaware, of the first unit of a plant to produce nylon textile yarns. Construction is expected to require 12 months and is scheduled to start at an early date. When completed the plant will be operated by the nylon division, rayon department of the du Pont Company, and will employ approximately 1000 people. Among the prospective uses for nylon are sewing thread, knit goods, fishing lines, woven dress goods, textile-finishing agents, and plastic compositions.

Although the price range of the new yarn has not yet been announced, it is generally believed that nylon will be inherently more expensive than rayons, and that for some time at least it may closely parallel silk in price. However, production facilities of the magnitude already announced certainly indicate the confidence of the du Pont Company in a substantial demand, even at initial high production costs, for their new products.

Carburetorless Gasoline Engines

THE AEROPLANE

THERE HAS been a great deal of discussion about the merits of replacing the carburetor on airplane spark-fired gasoline engines by some system of fuel injection. Those in favor of such replacement have argued that fuel injection would improve economy and prevent icing. Those in opposition have argued that such advantages would be offset by the complexity of the mechanism, the cost, and the difficulty of obtaining exact metering of the necessarily minute amounts of fuel. So it is interesting to read in the Oct. 19, 1938, issue of *The Aeroplane* of the carburetorless spark-fired gasoline engines being built in Germany by Junkers for commercial aviation service.

According to the article, lightweight fuel-injection engines were built on a mass-production basis for fast power boats of the German navy as early as 1917. The first engines of that type, the FO class, were the forerunners of both the Junkers airplane Diesel engines and the present-day Junkers airplane high-output fuel-injection gasoline engines of the 20- and 30-liter class.

Even though modern carburetor engines have attained a high degree of perfection, they are still afflicted with a number of deficiencies as regards the proper mixing and distribution of the fuel and air charge. The fact is known that in such an engine the fuel and air charge is not distributed uniformly in the cylinders because the jet must be set so as to supply a properly saturated mixture to the cylinder which is farthest away from the carburetor. Moreover, the composition of the charge varies with the engine load and the transition from the no-load jet to the main jet during quick acceleration is rather unsatisfactory. When flying at high altitudes there is the possibility of ice forming on the carburetor. Finally, the presence of a highly explosive fuel-and-air mixture near the combustion chambers may cause a fire.

In a fuel-injection engine each cylinder has an injection element of its own which can be accurately set to meet its requirements, thus making the charge uniform in all cylinders and over the whole range of engine speed. Direct injection of the gasoline and positive control of the fuel-and-air mixture completely eliminate all detrimental factors which are caused by fluctuations of temperature or change of weather. Moreover, with a fuel-injection engine there is no inconvenience caused by the transitory period in quick acceleration, because the injection pump can be set to a nicety so as to obtain utmost flexibility. As the air ducts are much simpler than those in a carburetor engine, the fuel supply to the cylinders is considerably improved.

Fuel-injection engines will perform satisfactorily at any desired height and are, therefore, specially adapted for military requirements. The danger of fire is considerably reduced as no highly explosive mixture is generated outside the combustion chamber. Direct injection also has a highly economical effect. Consumption figures are reduced by as much as 15 to 20 per cent, as compared with carburetor engines of equal power. In the Junkers fuel-injection engine, the take-off power has been increased by 10 per cent over that of a carburetor type.

The Junkers fuel-injection pump has 12 cylinders arranged in two blocks suspended in the form of an inverted vee. Each block comprises six piston pumps with fully automatic control. The drive is by a common crankshaft, each cam of which actuates a pair of opposite piston pumps. The piston travel is invariable and determined by the height of the cam. Fuel delivery is controlled by changing the effective stroke which is done by rotating the piston of each pump about its axis. The effect of this is such that its oblique edge bares the pump intake port, earlier or later. Lubrication and tight sealing of the pump pistons is by oil taken from the forced-feed lubricating-oil circuit. As a further safeguard, relief grooves are provided in the pistons. On the other hand, gradual infiltration of fuel into the oil pipe, when the engine is at a standstill, is prevented by clack valves arranged in the injection-pump oil-circuit.

Junkers fuel-injection gasoline engines are said to have set an excellent service record in the German Air Force, even under the most adverse conditions.

Gas Engines

AMERICAN GAS ASSOCIATION

USE OF GAS with internal-combustion engines to produce power has continued to advance most encouragingly throughout the country, according to a report made at the Atlantic City convention of the American Gas Association, Oct. 10–13, 1938, by E. P. Kramer, chairman of the Association's Committee on Gas Engine Power. The committee has spent two years analyzing the new trend toward use of metered gas to develop motive and electric power for wide varieties of industrial uses.

The nine gas-engine manufacturers, who supplied the committee with data, sold, in 1936, 290 gas engines capable of developing 37,900 hp, and in 1937, 524 units representing 67,257 hp. With regard to the uses to which this gas-developed motive power is put, 10 per cent runs electric generators, 68 per cent operates air compressors, 2 per cent moves cotton gins and cottonseed-oil mills, 5 per cent power air-conditioning and ice plants, and 15 per cent is utilized for pumping and other purposes.

Incidental applications of gas-engine power, but ones indicative of the ingenuity being exercised in the field, are installations where eight-cylinder engines are adapted for air compressors by having only four of the cylinders firing and the other

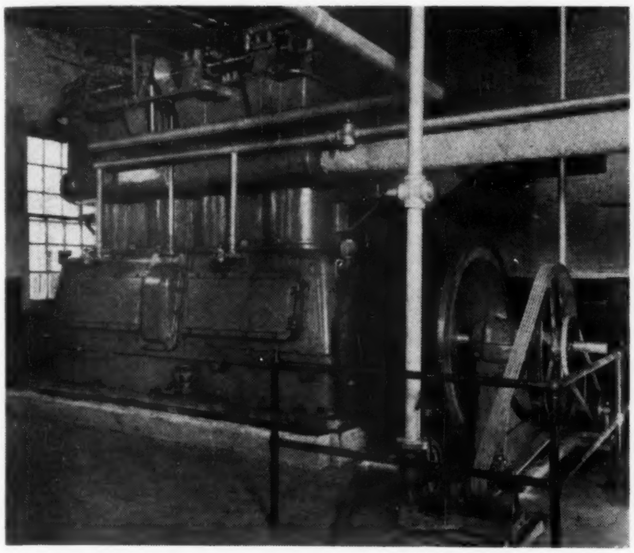


FIG. 2 450-HP BRUCE MACBETH GAS ENGINE DRIVING COTTONSEED-OIL MILL

four arranged for compressing air. Also, many cases are cited wherein simple adaptations of Ford, Lincoln-Zephyr, and Chevrolet gasoline engines are successfully and profitably installed for operation on natural gas. Even the mail-order division of Montgomery Ward is now offering a power unit for natural-gas input.

Mr. Kramer's committee further notes that most of the new Diesel-engine models are convertible to gas or can be offered for straight gas operation. Here is significant recognition of gas-engine power by manufacturers who have previously built straight Diesel engines. Such equipment is finding excellent acceptance in territories where: (1) Low year-round gas prices prevail and therefore straight Diesel sales are difficult, and (2) low gas prices are available for part of the year (during the off-peak gas season) and gas can be used off-peak and oil on-peak by converting the engine.

The most fertile direction for future advances in the gas-engine power field is along the line of waste-heat utilization. Chiefly "waste heat" from gas engines is used for heating water—water to be used either as circulating hot water or as boiler feedwater.

In the operation of natural-gas engines, a relatively small percentage of the total heat in the fuel consumed is utilized for useful work. The average natural-gas engine has a thermal efficiency, in operation, of approximately 25 per cent. The remaining heat is dissipated in jacket cooling water, radiation, friction, and exhaust gases. The heat in the engine jacket water and the exhaust gases represents nearly 65 per cent of the total heat value of the fuel. This may be reclaimed, in large measure, by the use of heat exchangers for jacket water cooling plus water jacketing of the exhaust lines from the engine.

It has been found that although it is possible to reclaim the "waste heat" from an internal-combustion engine to the extent of 90 per cent, it is usually practicable to reclaim only from 50 per cent to 60 per cent of this heat. To obtain 90 per cent recovery nearly three times the heating surface is required as would be used to reclaim 50 per cent of the waste heat. The expense of the additional and more elaborate heat exchangers and water jacketing which would be required to recover 90 per cent would, in most cases, be unwarranted economically in consideration of the low gas rates available for direct heating of water wherever gas-engine operation proves to be an economical source of power. It has also been shown to be economical to make use of the waste heat in exhaust gases and engine jacket water for heating buildings and factories.

In addition to waste-heat utilization, another field for helpful and needed investigations concerning gas for power production is along the line of the more economical loading of gas engines by an arrangement whereby the excess power-generating capacity of the engine at low loads may be utilized in the generation and in the storage of both electrical and heat energy.

Fuel-Oil Burner

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

ALTHOUGH the present type of pressure-atomizing oil burner has been extensively developed, it has a serious drawback in that, without recourse to a manual change in the size of the atomizer orifice, its operating range is limited, according to George P. Haynes and Samuel Letvin in a paper entitled "A New Fuel-Oil Burner," presented at the annual meeting, December, 1938, of The Society of Naval Architects and Marine Engineers.

In the burner described by the authors, and shown in section in Fig. 3, an attempt has been made to overcome this drawback. The design of the new variable-capacity fuel-oil atomizer consists structurally of the same members as the ordinary atomizer, except that an additional passage to return the oil and a separate atomizer orifice plate are provided.

The functions of the two additional members can be understood by referring to Fig. 3. The orifice plate is made dome-like so that it provides an annular space in the orifice for the oil to pass into the return just as it leaves the whirling chamber. The return passage is made by placing a large tube on the outside of the supply tube. The inner or supply tube carries the fuel oil to the sprayer plate, while the annular space between

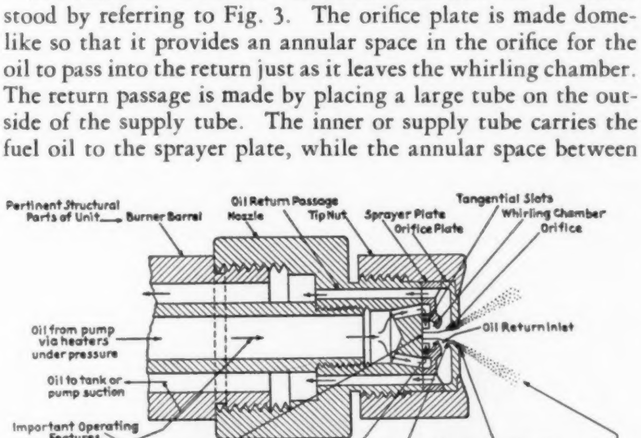


FIG. 3 SECTION OF NEW VARIABLE-CAPACITY FUEL-OIL ATOMIZER

the inner and outer tubes provides a return-flow passage. Oil under pressure is delivered through the inner tube to the annulus surrounding the whirling chamber from which it passes into the whirling chamber through a series of slots. Since these slots are tangent to the whirling chamber side wall, the oil rotates in this section of the sprayer plate and follows a spiral path as it progresses toward the outlet orifices. Entering these orifices, the pressure parallel to the axis of the sprayer plate, which is forcing the fluid outward, has been converted into velocity in the same direction due to the venturi action of the whirling chamber and its orifice. At the same time, after leaving the tangential slots, and for its entire travel, the whirling oil sets up a definite centrifugal pressure perpendicular to the axis of the sprayer plate. As the rotating mass reaches the

return annulus, the quantity of oil which is being by-passed will be forced into this opening by the centrifugal force, since there is no static pressure, this having been converted into velocity parallel with the sprayer-plate axis. At the same time the oil on the inner wall of the vortex, due to its centrifugal force, moves to a position nearer the side wall of the orifice previously occupied by the by-passed oil. This oil then leaves the confining walls of the orifice with its energy undiminished and atomization takes place.

The quantity of oil by-passed is a function of the return pressure. If the return-line valve is closed, a pressure gage placed in the line ahead of this valve will show the pressure in the orifice. As the return-line valve is opened this pressure will drop and the quantity returned will be proportionately increased, since the centrifugal force is transferred into velocity in the by-passed oil.

Tests with this variable-capacity atomizer have shown that the capacity range is exceptionally great. For example, a 1300-lb per hr atomizer has been operated continuously and satisfactorily at 17 lb per hr. This is a range of approximately 76 to 1.

The authors present curves to show that the CO_2 in the flue gases at trace smoke, obtained by test with the new burner, lay between 14 and 13.5 per cent from approximately 175-lb per hr per burner to a top rate of 550 lb per hr for one size of sprayer plate, and to a top rate of 1300 lb per hr per burner for a larger size of sprayer plate.

A New Type of Rotary Engine

THE AEROPLANE

A NEW VERSION of a rotary airplane engine has been invented by a Hungarian engineer, M. Sklenar, and is attracting much attention in France. According to an article in the Oct. 19, 1938, issue of *The Aeroplane*, an order has been placed for twenty by the French Air Ministry. In the old type of rotary, the whole engine turned around the fixed crankshaft.

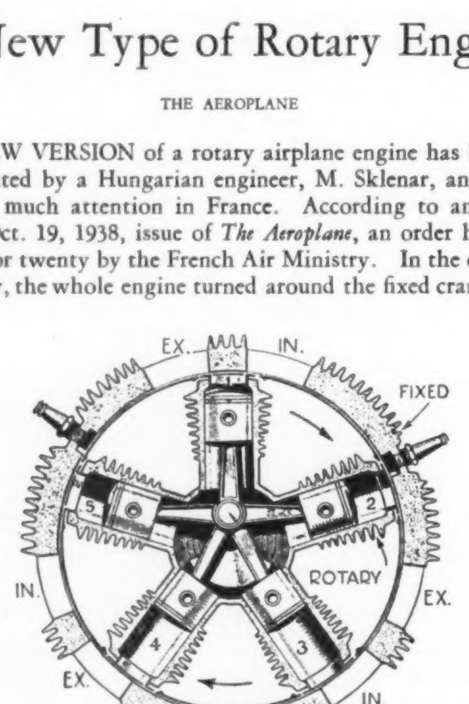


FIG. 4 SKLENAR ROTARY ENGINE

Mr. Sklenar's idea, as shown in Fig. 4, is to have the crankshaft turn at up to 4000 rpm and to allow the cylinders to turn also but at one-ninth crankshaft speed.

The cylinder jackets rotate inside a fixed crown or circumferential head in which are inlet and exhaust ports and spark plugs. In this way the cylinders are charged as they pass an inlet port, fired as they pass the spark plug, and then exhausted as they go by an exhaust port. The arrangement has the advantage of providing very large areas for the incoming and outgoing gases, and also the advantage of shutting off the spark plug from the hot gases as soon as the charge has been exploded.

Sealing between the ends of the cylinders and the circumferential head is accomplished by means of annular shoes between the cylinder jackets and the head. Centrifugal force helps to press the shoes more tightly against the inner face of the head. A nine-cylinder engine of this type has been built and developed 350 hp. Designs are now being made for a double-row engine of 700 hp. Two companies, one in France and the other in the United States, have been formed to build these engines.

Turbine-Generator Standards

NATIONAL DEFENSE POWER COMMITTEE

THE National Defense Power Committee on November 14 approved the report of its Subcommittee on Standardization establishing, for the first time in the history of the electrical industry, preferred standards for steam-turbine generators of 10,000 kilowatts rating and above with a view to expediting the production and reducing the costs of such equipment. The adoption of these standards is expected materially to accelerate the construction and erection of generating stations to provide additional supplies of electric energy. The committee is considering similar determinations for generators of smaller ratings.

Definite standards of pressure, temperature, voltage, power factor, and other technical features, are provided for nine sizes of condensing turbines, ranging from 10,000 to 100,000 kilowatts and for eight sizes of superposed turbines ranging from 10,000 to 60,000 kilowatts.

The Subcommittee on Standardization, of which Commissioner Basil Manly of the Federal Power Commission is chairman, while establishing these preferred standards, has been careful in its report to provide sufficient latitude for the modification of the standards to meet the special conditions arising in connection with the installation of new equipment in existing plants or where unusual physical conditions must be met. Provision is also made for the consideration of technical advances in the art. But in every case where deviation from the preferred standards is suggested, the burden of proof will be upon the utility or manufacturer proposing such deviation. The committee will at all times welcome constructive suggestions from the industry.

A technical report prepared for the Subcommittee by John C. Parker, president of the American Institute of Electrical Engineers and vice-president of the Consolidated Edison Company, representing the utilities, C. S. Coggeshall, sales manager, turbine department of the General Electric Company, representing the electrical-equipment manufacturers, and Thomas R. Tate, representing the National Defense Power Committee, contains the following comments:

Your Subcommittee on Standardization of Turbine Generators has held two meetings, one on October 20, and another on November 3, at which representatives of the turbine-generator manufacturers, utilities, and the government were present and cooperated wholeheartedly in discussing the adoption of preferred standards for steam-turbine generators. The subcommittee has unanimously agreed upon and recommends for adoption by industry and the manufacturers the standards set forth herein.

The immediate objective of the establishment of preferred standards for tubine generators is the maximum speed of provision of power facilities to anticipate peace-time requirements

PREFERRED STANDARDS FOR STEAM-TURBINE GENERATORS

TABLE 1 - CONDENSING TURBINES

GENERAL: All sizes - back pressure 1" or 1½" Hg. Abs.; Short Circuit ratio 0.9; Generator voltage 13,800; Excitation voltage 250.

Item Nos.										
1	Rating - Kw	10,000	12,500	15,000	20,000	25,000	35,000	50,000	75,000	100,000
2	RPM	3,600	3,600	3,600	3,600	3,600	3,600	3,600	1,800	1,800
3	Throttle pressure Lb. per Sq. in. gauge	650	650	650	850	850	850 or 1,250	850 or 1,250	850 or 1,250	850 or 1,250
4	Throttle temperature °F	825	825	825	900	900	900	900	900	900
5	Number of extraction openings	3	3	3	3	3	4	4	4	4
6	Temperature at extraction openings ± 10°F (at rated output)	170/225/290	170/225/290	170/225/290	170/225/290	170/225/290	170/225/290/350	170/225/290/350	170/225/290/350	170/225/290/350
7	Turbine capacity in percent of kw rating	125	125	125	125	125	125	125	125	125
8	Power factor	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
9	Generator cooling (Air or hydrogen)	Air	Air	Air	Air	Air or Hyd.	Hyd.	Hyd.	Hyd.	Hyd.

TABLE 2 - SUPERPOSED TURBINES

GENERAL: All sizes - 3600 RPM; Throttle pressure and temperature 1250 lb./sq. in. gauge, 925°F; Back pressure 200-300 lb./sq. in. gauge; Short circuit ratio 0.8; Generator voltage 13,800; Excitation voltage 250.

10	Rating - Kw	10,000	12,500	15,000	20,000	25,000	35,000	50,000	60,000
11	Turbine capacity in percent of kw rating	111	111	111	111	111	111	111	111
12	Power factor	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8 or 0.9
13	Generator cooling (Air or Hydrogen)	Air	Air	Air	Air	Air or Hyd.	Hyd.	Hyd.	Hyd.

and to facilitate war-time provision of power through elimination of any unnecessary special designs or sizes. It is expected, incidentally, that the cost of power-plant installations will be sufficiently reduced to compensate for any added economy or for other advantages that might result from more special designs.

It is the belief of your subcommittee that the advantages of preferred standards as here recommended for turbine generators will be reflected also in such associated equipment as boilers and appurtenances, steam piping, valves, and fittings.

It is the intention that the preferred standards agreed upon by representatives of the government, the manufacturers, and the utilities will be followed in the building of all new generating stations and in all installations within existing stations unless interrelation with existing equipment clearly calls for special designs. Deviation from these proposed standards if of decided advantage to the public, or if necessitated by physical conditions, or by the fundamental purpose of rapid creation of power facilities for national defense will be deemed to be consistent with this program. In all such cases the burden of clear proof rests upon anyone proposing such deviation.

Illustrative of such cases in which deviation will be deemed to be in the spirit of this program—but not intended to be all inclusive—are the following:

(1) The temperature of condensing water supply may require turbines designed for operation with back pressures higher than herein provided

(2) The present availability in manufacturers' plants of turbine generators well advanced in production points clearly to the completion and use of such equipment

(3) Duplication of a turbine generator, not currently discontinued by the manufacturer as an active design, may expedite manufacture and installation of power facilities

(4) The manufacture and installation of turbine generators adapted to meet essential requirements in existing stations may facilitate rapid creation of generating capacity.

The preferred standards are intended to be progressive standards and, consistently with the fundamental purpose of expediting production and installation of power-generating equipment, are intended to permit technical and economic developments. To that end they should, at least annually, and as occasion seems clearly to warrant, be reviewed to determine whether advances in the art call for specific modification.

While the advantages of unified practice with reference to associated equipment, such as condensers, piping, pumps, and boilers are of great significance, the subcommittee recognizes that the difficulty of standardization is probably greater than in the case of turbine generators and is not prepared at the present moment to make specific recommendations. It does, however, wish to suggest the desirability of further consideration.

The accompanying tables show the preferred standards for steam-turbine generators which were adopted by the subcommittee on Standardization of the National Defense Power Committee.

Standard Vegetables

AMERICAN STANDARDS ASSOCIATION

GROWING vegetables in standard sizes and shapes is the latest development in the agricultural field, as brought out at a recent convention of the Vegetable Growers Association of America and reported in the November, 1938, issue of *Industrial Standardization*, official publication of the American Standards Association. According to the article, this development will have an important effect on the entire process of growing and distributing vegetables.

With the use of standard containers it has been found desirable to grow vegetables of uniform size to fit them. Already, the curved neck has been removed from the summer squash, cucumbers have been straightened out and given a more uniform thickness, celery is being grown with shorter stalks and less foliage above the bunch to conform better with standard container dimensions.

THE AUDITORIUM IS WELL-

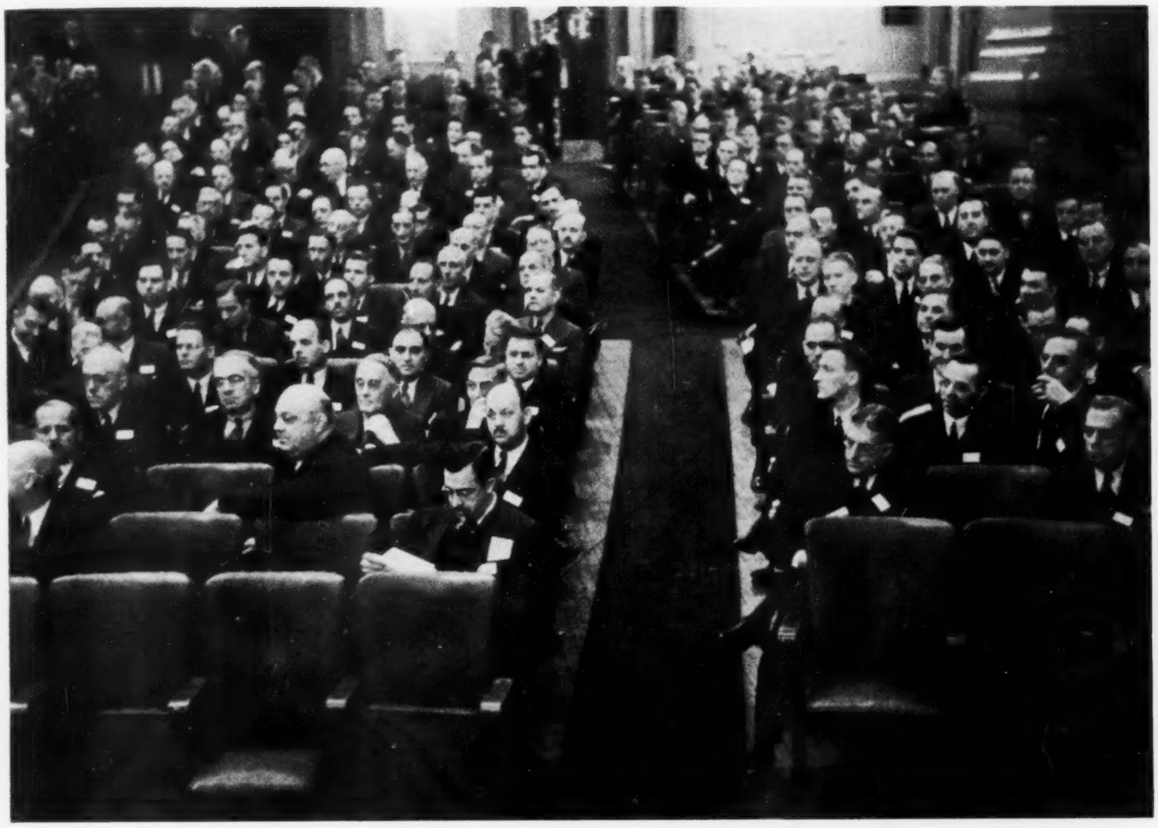
AT THE A.S.M.E. 1938

I—PRESENTING A GENERAL IMPRESSION

THE NUMBER and variety of the ways in which instruction and entertainment are provided for members and guests at an Annual Meeting of The American Society of Mechanical Engineers present a discouraging task to anyone who attempts to paint a reasonably accurate word picture of the six-day activities of 2500 participants. Indeed, were one merely to stick his head into every meeting room and odd corner where mechanical engineers, during several confusing days, transact official and unofficial business, he would find the major portion of his time occupied in dashing up and downstairs, fighting his way on and off crowded elevators, and running up taxi bills in an effort to spread himself out as thin as a movie-camera film, and he would probably come to the conclusion that he was engaged, not in a reportorial job, but in an obstacle race. Experience would teach him that the practical approach to such a task is to use his legs as little as possible, keep his eyes and ears open, and attempt to crystallize and record a general impression with the aid of as much factual information as he can pry out of harassed committeemen, secretaries, and innocent bystanders. If he does this, and adds a liberal sprinkling of photographs supplied by an irrepressible candid cameraman (for whom one who earns his daily wage with a pencil must necessarily look upon with a feeling of professional jealousy), a story somehow emerges from chaos and the voices of those who clamor for copy are silenced.

VARIETY ADDS TO THE SPICE OF THE MEETING

The American passion for competition is humored by The American Society of Mechanical Engineers in its Annual Meetings with an attention that should excite the approbation of Senator O'Mahoney's antimonopoly committee. The old stager who has fallen into the clutches of those who condemn him to the rock pile of committee work is denied access to the intellectual ozone that permeates the atmosphere in which technical papers are discussed. Office bearers and official representatives of the Society's far-flung membership must content themselves with tobacco smoke and the weighty substance of senatorial debate. Avid seekers after truth and knowledge find themselves torn between attention to technical papers and the inspection of local plants. Some members frankly seek the comfort of overstuffed chairs and let the world and their friends come to them, or they teeter from heel to toe in the lobby, where they are backslapped and buttonholed by the restless visitors who surge around them. None can do all these things, except in moderation, and each patterns his conduct to that means of getting the most out of a meeting which experience has taught him best suits his humor. But everyone has to eat, so that adjournment from all these varied occupations is taken twice a day at least—an adjournment, nevertheless, that does not interrupt the flow of serious discussion and friendly conversation, which, after all, constitute the most conspicuous feature of these gatherings.



FILLED FOR A TECHNICAL SESSION

ANNUAL MEETING

Such, in a few lighthearted words, was the general atmosphere of the Fifty-Ninth Annual Meeting of The American Society of Mechanical Engineers, held in New York at the Engineering Societies Building and near-by hotels, clubs, and restaurants, Dec. 5–9, 1938; and such it superficially might appear to a newcomer on the scene. But, in spite of appearances, the seething vapors of such a scene do not obscure from keen observers the wholesome source from which they arise. Content to prove the pudding when it cools, such persons are confident of its excellent quality and are eager to pluck forth the plums with which they know the cooks have stuffed it.

PICKING OUT SOME OF THE PLUMS

Opinions will differ as to what features of the meeting turned out to be the plums, but one observer's views are as follows: The easy-to-understand "Summary of Financial Statement for 1937–1938" (see pages 69 to 70 of this issue) that President Davis happily referred to as the "streamlined" finance report; the conferences of local sections' group delegates, a familiar institution that this year reached a new high in useful performance; the brand-new collateral conference of professional-divisions delegates; an almost perfect annual dinner, delightfully presided over by Past-President W. L. Batt, toastmaster, and marked by two brilliant addresses, one by President Harvey N. Davis, a thoughtful and scholarly presentation of "An Engineer's Philosophy," and the other the Thurston Lecture, "Physiology for the Engineer," by Howard W. Haggard, of Yale University; the simple dignity of the presentations of Honors Night, capped by the inspiring Towne Lecture, "Mechanical Engineering—Materials, Methods, and Men," delivered by Gerard Swope, of the General Electric Company; the dinner of the Division of Applied Mechanics in celebration of the sixtieth birthday of Stephen Timoshenko; the reappearance on the Annual Meeting scene of preprints of papers for use at technical sessions; the technical papers themselves; many committee meetings whose importance must be individually assessed; the announcement of the formation of a "design committee;" and, finally, the admirable manner in which President Davis handled the annual business meeting.

II—COUNCIL MEETS EARLY AND LATE

Between their official duties and their public appearances, members of the Council were kept busy. Work began for the Executive Committee on Sunday morning. Adjourning Sunday afternoon for the tea given by Secretary and Mrs. C. E. Davies at the Engineering Woman's Club, Council members returned to the Engineers' Club at 6:30 to meet with delegates of the local sections and representatives of Society committees, where all were greeted by President Davis, who announced the death, on December 3, of Paul Doty, member of Council, and president of the Society in 1934.

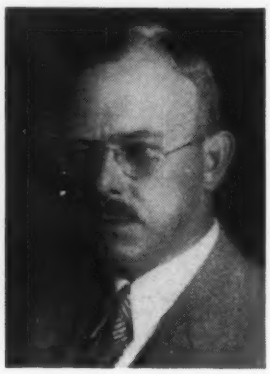
The Report of the Council for 1937–1938, which is to be found

J. W. PARKER
Vice-President

W. LYLE DUDLEY
Vice-President

ALFRED IDDLES
Vice-President

H. H. SNELLING
Vice-President



CLARKE FREEMAN
Manager

W. H. WINTERROWD
Manager

W. R. WOOLRICH
Manager

New Members of 1939 A.S.M.E. Council

on pages 59 to 65 of this issue, was summarized by Secretary Davies, and the report of the Finance Committee (pages 66 to 68) was presented by K. M. Irwin, chairman of the committee. The "Summary of Financial Statement for 1937–1938" (pages 69 to 70) was received with much enthusiasm and approval was expressed of the conservative figures presented in the report. Discussion then switched to the "Parker case" and to publications and preprints. At eight o'clock adjournment was taken for a buffet supper and social hour.

For the Council, Monday provided an all-day session, interrupted by a luncheon at the Hotel Astor with delegates and committeemen, and by the annual business meeting at 4 p.m. Tuesday night the Council dined with the recipients of honors prior to the exercises of Honors Night, and Wednesday noon it met at luncheon with the student members. Friday morning, with Harvey N. Davis in the chair, the 1937–1938 Council met for its concluding session, and the 1938–1939 Council convened for its first session under the presidency of A. G. Christie.

Friday afternoon the new Executive Committee of the Council, consisting of A. G. Christie, chairman, James W. Parker, Harte Cooke, Kenneth H. Condit, and Clarke Freeman, held its first session.

Actions of the councils and executive committees are to be found on pages 88 to 91 of this issue.

DEATH OF PAST-PRESIDENT PAUL DOTY NOTED

One of the first actions of the Council on Monday morning was the adoption of resolutions on the death of Past-President Paul Doty. The resolutions read as follows:

WHEREAS, The American Society of Mechanical Engineers and this Council have lost by death one of their most devoted, valuable, and loyal members, and past-presidents

COLONEL PAUL DOTY,

admitted as an Associate Member in 1891, transferred to Member in 1904, and to fellow in 1936; chairman of the Committee on Local Sections 1929; manager 1925–1929; Vice-President 1929–1931; President 1934; and

WHEREAS, In the death of Colonel Doty the Nation has lost one of its most distinguished engineers and the Society one of its best loved members, and

WHEREAS, he was a Lieutenant Colonel of Engineers in the World War, and an engineer whose lifework was in the design, operation, and management of public utilities, gas works, electric plants, and street railways and

WHEREAS, this Society will best recall Colonel Doty for his work and activities in the interest and advancement of the Society and its objectives, and as a leader in the registration of engineers in this country, be it therefore

Resolved, That the officers and Council of The American Society of Mechanical Engineers record their deep sorrow and profound sense of loss in the passing of one whose opinions and advice were so highly esteemed, and be it

Resolved, That this expression of sorrow and sense of loss be made a part of the Minutes of the Council of The American Society of Mechanical Engineers, and be it further

Resolved, That a copy of this resolution be sent to Mrs. Paul Doty and Miss Doty with assurances of sincere sympathy.

ANNUAL BUSINESS MEETING DRAWS A CROWD

The Annual Business Meeting of the Society was called to order by President Harvey N. Davis at 4 p.m. on Monday, Dec. 5, 1938, in the Engineering Societies Building with an unusually large attendance. Secretary C. E. Davies presented the report of the Council for 1937–1938, and K. M. Irwin summarized the report of the Finance Committee. Printed copies of both reports (see pages 59 to 70) were distributed.

Mr. Davies called particular attention to the return of preprints of meeting papers and the changes in publishing Transactions that provide for printing of papers, complete with discussion and author's closure, after presentation. He also noted such items as the work of the Engineers' Council for Professional Development, changes in membership, the new plan of junior-member dues, the election of the first group of "fellows," and the "Parker case."

For purposes of the record, as required by the constitution of the Society, he announced that a statement had been signed by the president and treasurer which listed the property and assets of the Society and stated where inventories and investments are to be found, and also included a schedule of items expended during the year.

On motion it was voted "that we approve the reports and the acts and transactions of the Society and its Council during the year from Sept. 1, 1937, to Sept. 30, 1938." Discussion of the motion centered around the "Parker case," and was largely contributed by Mr. Parker himself, who rose on a point of personal privilege.

1939 NOMINATING COMMITTEE ANNOUNCED

Announcement of the personnel of the Nominating Committee for 1939 was made by W. R. Woolrich, chairman of the Committee on Local Sections. The 1939 Nominating Committee is constituted as follows:

Group I: Dean W. L. Edel, *representative*, Connecticut State College, Storrs, Conn.; C. Harold Berry, *alternate*, Harvard University, Cambridge, Mass.

Group II: T. Baumeister, Jr., *representative*, Columbia University, New York, N. Y.; A. R. Mumford, *alternate*, New York Steam Corp., 130 E. 15th St., New York, N. Y.

Group III: B. F. Rogers, *representative*, 650 Rutter Ave., Kingston, Pa.; C. F. Dietz, *alternate*, Lamson Co., Syracuse, N. Y.

Group IV: Dean Blake R. Van Leer, *representative*, North Carolina State College, Raleigh, N. C.; J. B. Jones, *alternate*, Virginia Polytechnic Institute, Blacksburg, Va.

Group V: F. C. Hockema, *representative*, Purdue University, Lafayette, Ind.; C. L. Bauer, *first alternate*, Bauer Bros. Co., Springfield, Ohio; S. R. Beitler, *second alternate*, The Ohio State University, Columbus, Ohio.

Group VI: Harold A. Smith, *representative*, Standard Oil Company of Indiana, Sugar Creek, Mo.; Linn Helander, *alternate*, Kansas State College, Manhattan, Kan.

Group VII: C. I. Carpenter, *representative*, 1516 Old National Bank Bldg., Spokane, Wash.; D. R. Gray, *alternate*, Box 1483, Spokane, Wash.

Dean Edel serves the committee as chairman and Mr. Rogers as secretary.

III—LOCAL SECTIONS GROUP DELEGATES CONFERENCE

In order to refresh the memories of many members of the Society on the organization of the Local Sections Group Delegates Conference, it should be stated that for purposes of administration the local sections are divided into seven regional groups. During the fall months a conference of delegates takes place in each of these regions and seven delegates are appointed to represent the seven regional groups at the conference in New York. The term of office is for two years, so that the New York conference is made up of 14 delegates. The New York conference has a speaker, a vice-speaker, a secretary, and four committees on budget, membership, organization, and agenda and miscellaneous. For the consideration of the New York meeting, the resolutions presented by the seven regional conferences are summarized and classified, and the Group Conference passes on to the Council its own resolutions that result from joint discussion.

FOURTEEN DELEGATES REPRESENT ENTIRE COUNTRY

Delegates to the 1938 Annual Meeting Conference were the following:

Group I: C. P. Howard, Worcester, Mass. (1 year), Worcester Section; R. A. Spence, Boston, Mass. (2 years), Boston Section; W. C. Zinck, New Britain, Conn. (alternate), New Britain Section.

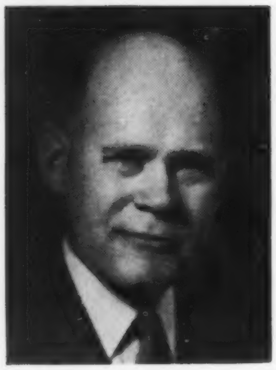
Group II: John M. Driscoll, New York, N. Y. (1 year), Metropolitan Section; Charles A. Hescheles, Brooklyn, N. Y. (2 years), Metropolitan Section.

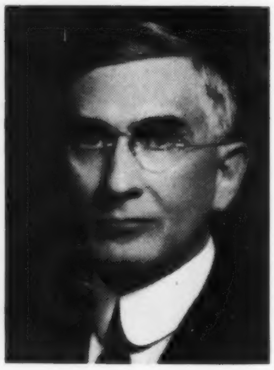
Group III: Paul B. Eaton, Easton, Pa. (1 year), Anthracite-Lehigh Valley Section; Frederick C. Stewart, State College, Pa. (2 years), Central Pennsylvania Section, who was represented by his alternate J. T. Rea, Bethlehem, Pa., Anthracite-Lehigh Valley Section.

Group IV: W. E. McDowell, Spencer, N. C. (1 year), Charlotte Section; N. C. Ebaugh, Gainesville, Fla. (2 years),

LOCAL SECTIONS GROUP DELEGATES AT 1938 A.S.M.E. ANNUAL MEETING

[*Sitting* (left to right) D. K. Hutchcraft (Tulsa, Okla.), C. P. Howard (Worcester, Mass.), Paul B. Eaton (Easton, Pa.), Charles A. Hescheles (New York, N. Y.), and Joseph T. Rea (Bethlehem, Pa.). *Standing* (left to right) E. R. McCarthy (Cleveland, Ohio), C. J. Freund (Detroit, Mich.), John M. Driscoll (New York, N. Y.), W. E. McDowell (Spencer, N. C.), R. A. Spence (Boston, Mass.), A. L. Hill (Denver, Colo.), S. F. Duncan (Los Angeles, Calif.), N. C. Ebaugh (Gainesville, Fla.), and Ralph E. Turner (Chicago, Ill.).]





P. B. EATON L. K. SILLCOX

(Professor Eaton of Group III acted as chairman of the Conference of Local Sections Delegates and Mr. Sillcox as chairman of the Professional Divisions Conference, both groups meeting during the 1938 Annual Meeting of the A.S.M.E.)

Florida Section; HARRY R. PEARSON, Dallas, Texas (alternate), North Texas Section.

GROUP V: E. R. McCARTHY, Cleveland, Ohio (1 year), Cleveland Section; C. J. FREUND, Detroit, Mich. (2 years), Detroit Section.

GROUP VI: D. K. HUTCHCRAFT, Tulsa, Okla. (1 year), Mid-Continent Section; R. E. TURNER, Chicago, Ill. (2 years), Chicago Section; FRED B. ORR, Chicago, Ill. (alternate), Chicago Section.

GROUP VII: A. L. HILL, Denver, Colo. (1 year), Colorado Section; S. F. DUNCAN, Los Angeles, Calif. (2 years), Los Angeles, Section; W. D. TURPIN, Salt Lake City, Utah (alternate), Utah Section.

For this conference, Professor Eaton acted as speaker and Mr. Howard as vice-chairman. The secretary was C. A. Hescheles. Chairmen of the committees were: Budget Committee, W. E. McDowell; Membership Committee, E. R. McCarthy; Organization Committee, D. K. Hutchcraft; and Agenda and Miscellaneous Committee, John M. Driscoll.

SPEAKER PAUL B. EATON SUMMARIZES WORK OF CONFERENCE

In summarizing the work of the Conference, Professor Eaton said:

Among the sixty items pertaining to the problems of the local sections considered by the delegates at the national meeting, two assumed paramount importance: Cooperation between the professional divisions and local sections for better program building in the local sections; and the matter of employment and welfare.

The joint meeting of the professional-divisions representatives and the local-sections delegates which took place this year is the first step in a movement that will lead to a better understanding of mutual problems and endeavors. A similar meeting next year should complete the mechanisms necessary for successful operation.

The hearty reception the Council accorded the recommendations presented from the local-sections delegates augurs well for the year lying ahead—a year of service to the Society.

ACTIONS OF CONFERENCE EMPHASIZED AT COUNCIL MEETING

At the meeting of the Council on Friday, Professor Eaton emphasized the following portions of the actions of the Conference:

The Committee on Local Sections, the Finance Committee, and Council are strongly urged to take the necessary action to increase the appropriation for local sections, so as to restore the work done by them to full strength and effectiveness.

It is recommended that the matter of travel allowance be reviewed to the purpose of providing an allowance based on actual reasonable expenditures.

The election of officers of local sections should be held at least three months before the time they will assume office, and headquarters should be given promptly the names of those elected in order that a copy of the "Manual for Local Sections Operation" may be forwarded to them.

The continuance of visits by national officers to local sections' meetings is strongly recommended.

Immediate steps should be taken by headquarters to promote the cooperation between the professional divisions and the local sections. Representatives of both these groups should meet annually to discuss methods of improving these relations and to realize the maximum benefit of the recognized advantages.

It is suggested that the recommendations of the Group Delegates Conference, and action of Council on these recommendations be published in the June issue of MECHANICAL ENGINEERING.

Headquarters should be commended for its cooperation in compiling the list of speakers, and in the arrangement of local-sections programs.

It is recommended that membership dues for all grades of membership in A.S.M.E. remain as at present.

Local sections should extend to the Committee on Local Sections the fullest possible support and cooperation in its plans for the Sixtieth Anniversary Meeting in April, 1940.

A reasonable registration fee should be charged nonmembers attending national meetings, and a suitable mechanism should be established to waive this fee in cases of speakers, invited guests, members of cooperating societies in joint meetings, and on account of special circumstances of time and place.

A functional organization chart should be prepared and copies distributed to chairmen and secretaries of local sections, or incorporated in the record books.

It is suggested that the Society, upon request, mail the summer copies of MECHANICAL ENGINEERING to students, and publish this decision in the May issue.

Copies of the "Employment Service Bulletin" should be sent to the secretary and employment coordinator of each section making application for this service.

It is recommended that the Council consider the continuance of a progressive long-time program looking toward the establishment of branch employment offices in key cities throughout the nation.

These, and other actions of the Conference, will be referred by the Council to appropriate Society agencies for consideration and recommendation.

COUNCIL, COMMITTEEMEN, AND DELEGATES LUNCH TOGETHER

At the Hotel Astor on Monday noon, the delegates to the Group Conference met with members of the Council and committeemen at luncheon. W. R. Woolrich, chairman of the Committee on Local Sections, presided. He introduced Harte Cooke, who announced that a joint meeting of the group delegates with the delegates of the professional divisions had been arranged.

President Harvey N. Davis spoke briefly, and President-Elect A. G. Christie said that in order for the Society to serve the local sections it was necessary to know what the local sections wanted. He said that pressure of university duties would make it impossible for him to travel as extensively as he would like, but he would fill as many engagements as his time and energy would permit.

IV—PROFESSIONAL DIVISIONS STAGE A NEW CONFERENCE

Success of the Local Sections Group Delegates Conference in providing a forum for the discussion of problems related to the local sections and their interests led K. H. Condit, about a year ago, to suggest a parallel conference to be composed of representatives of the professional divisions, and to concern itself with building up the technical interests of the Society. Such a conference was arranged for the 1938 Annual Meeting and was called to order by L. K. Sillcox, chairman of the Committee on Professional Divisions, on the morning of December 5.

DIVISIONS REPRESENTED AT CONFERENCE

Attending the conference were the following:

From the Basic Science Department of Divisions: G. B. Karelitz, head of the department; R. Eksergian, Applied Mechanics; T. B. Drew and W. S. Patterson, Heat Transfer Group; and F. G. Switzer, Hydraulic.

From the Manufacturing Department: Victor Wichum, head of the department; B. D. Stevens, Graphic Arts; M. Stone, Iron and Steel; J. H. Sengstaken, T. R. Olive, A. F. Spitzglass, and F. L. Yerzley, Process Industries; and R. H. McCarthy, Wood Industries.

From the Power Department: W. A. Carter representing Harte Cooke, head of the department; W. G. Christy and A. R. Mumford, Fuels; E. J. Kates and M. J. Reed, Oil and Gas Power; G. A. Gaffert and O. F. Campbell, Power.

From Transportation and Management Department: L. K. Sillcox, head of department; Jerome Lederer, Aeronautic; C. F. Ripley, Lawford Fry, and M. B. Richardson, Railroad; W. H. Kushnick and L. N. Rowley, Jr., Management.

Other members present were: R. F. Gagg, Meetings and Program; C. B. Peck, Publications; J. M. Todd, New Orleans Meeting committee; W. A. Shoudy, E. Caruthers, Jr., and Sam Shoor, Committee on Professional Divisions; and H. B. Fernald, Jr., recorder.

L. K. SILLCOX OPENS FIRST PROFESSIONAL DIVISIONS CONFERENCE

In a brief address at the opening of the conference Mr. Sillcox called attention to the fact that in it a new Society service was being inaugurated. He showed how a professional division is a working organism within the Society, and reminded the representatives of the wide diversity of interest represented by the Society's membership. Program making, selection and evaluation of technical papers, and thus the building of Society prestige, he said, will always remain the peculiar responsibility of the professional divisions. Continuing, he said:

In a society such as ours, there are two hazards which require that we be ever alert, that they may not threaten the universal service which the Society can perform. The first is domination by a group; the second, the tendency toward mediocre procedure when division activities are directed by men less alert and faithful to their accepted task than their offices require.

An inactive division, despite the interest of a distinct group of Society members who look to the division for service benefit to which their Society membership entitles them, gradually forfeits leadership. On the other hand, a particularly active and energetic division develops broad and well-coordinated programs. It expands its influence and function, tending to eclipse the wholly drab and unspectacular existence of the lesser division. Complaints are heard, criticizing a dominating group. It may be a professional division or it may be a local section. The problem is not that of bridling the ambitious program, it is the stimulation of delinquent divisions or sections. In some few cases, one division or section enjoys some peculiar advantage, particularly in the scope of member interest. In such cases, the coordinating agencies, staff, and the standing committees, stand ready to serve in equalizing opportunities.

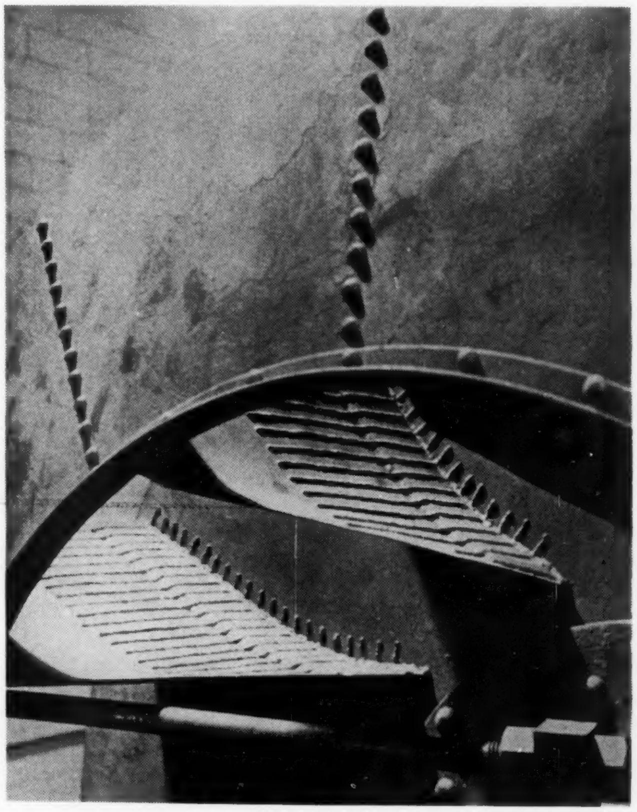
Again the delinquent professional division generally tends toward the indifferent administration of its affairs. It arranges its technical programs in a disinterested, routine fashion. Technical papers are solicited from its members. None are volunteered. The member who agrees to participate is given full latitude. Commercialism can assume any proportions, duplication and interference with other presentations become common. Individual views which can find no practical application find their way into our journal. This has become the concern of your Standing Committee and has given rise to the 90-day rule for submission of papers to be presented at technical sessions. The rule is admittedly revolutionary in character in so far as the Society is concerned. Already it has been both applauded and derided. Its object is that of assuring proper discrimination in the selection of material which, once presented in technical session, becomes widely accepted as Society-sponsored, despite any number of footnotes to the contrary.

It is in the formulation of policy and supervision over the Society's essential function that the professional divisions serve. They could have no greater task. The men who are here are doubtless those who have been selected because of personal progress in the type of work which the divison represents and who, by particular devotion to division and Society matters, are known to be qualified. It is unfortunate that my message cannot be directed to those other division affiliates who treat their responsibilities casually, yet are first to criticize any curtailment in division function. I trust the sense of our meeting will effectively reach them.

When all is said and done, it must be realized that there are just three approaches to the individual member and, in the end, he is the one we must satisfy, otherwise our work will fail. We contact the membership through (1) our publications, (2) through the local sections, and (3) at our national meetings. The character of these three avenues of association is profoundly influenced by the type and caliber of program, papers, and discussion we evolve, all of which require advance preparation and planning. This is a vital function of joint endeavor, comprising the active and intelligent cooperation of (1) the local sections, (2) the professional divisions, (3) the officers, and (4) the staff of the Society. If we realize sufficiently the problem and our opportunities we should do our utmost to make each member conscious of the good his membership represents to him as an individual and in raising his professional status as an engineer also of our society as a national asset. This means more and better work than we have ever done before in this direction, but it must be a joint and united effort if ever it is fully to succeed.

MANY SUBJECTS DISCUSSED AT CONFERENCE

After Mr. Sillcox completed his address, there was a discussion of the 90-day rule. Opinions were expressed in favor of the rule and on the desirability of compliance with it by all divisions. This led to a consideration of means by which the best papers can be secured and to an explanation of the Society's preprint procedure. Mr. Peck, for the Committee on Publica-



"FANTASY"

(Photograph by A. R. Parker shown at the Photographic Exhibit of the 1938 A.S.M.E. Annual Meeting.)

1938 Annual Meeting in Pictures

[(1) At the speakers' table at the Annual Dinner, Scott Turner, A. G. Christie, and H. W. Haggard. (2) The President's Reception with Professor and Mrs. Christie greeting Charles T. Main and Elizabeth Coit. (3) Further along at the speakers' table were F. M. Farmer, C. W. Spicer, and William McClellan. (4, 6) The guests at the Annual Dinner held at the Hotel Astor. (5) Going down the receiving line to greet the new president. (7) Dr. Howard W. Haggard, delivering the Thurston Lecture after the dinner. (8) American Gage Design Committee meets. (9) William L. Batt, toastmaster at the dinner. (10) Industrial power luncheon was also a technical session. (11) Some members of the A.S.M.E. Council at one of its sessions. (12) Power Test Codes Committee in session.]

1938 Annual Meeting in Pictures

[(1) Honors Night with Gerard Swope delivering the Towne Lecture, while on the platform from left to right are Charles T. Main, Lawford H. Fry, W. H. Tschappat, Alex Dow, Harvey N. Davis, A. G. Christie, Francis Hodgkinson, Geo. A. Orrok, A. I. Lipetz, Harte Cooke, and D. S. Jacobus. (2) Honors Night Audience. (3) J. W. Roe talks it over with K. H. Condit. (4) H. L. Dryden, Jerome C. Hunsaker, E. O. Waters. (5) Just getting ready to go at the Council Dinner. (6) At a technical session with L. M. Goldsmith, A. L. Baker, and F. Umbehocker in the foreground. (7) R. D. Gillespie, C. H. Spiehler, and C. W. DeForest are being hard to convince. (8) Waiting to tell an author the way they do it. (9) J. M. Lessells, J. P. DenHartog, and George B. Pegram tell applied mechanics stories.]




D. C. MC SORLEY HUBER O. CROFT MARSHALL C. LONG F. V. LARKIN

(At Honors Night Professor Croft presented Mr. McSorley for the Undergraduate Student Award and Professor Larkin presented Mr. Long for the Postgraduate Student Award.)

tions, emphasized the importance of keeping papers, in so far as it is practicable to do so, within the limit of 4000 words.

Attention was then directed to budgetary matters and to details of the proposed programs for the meetings at New Orleans (Feb. 23–25), San Francisco, Calif. (week of July 10), New York (week of September 4) jointly with the Institution of Mechanical Engineers (Great Britain), and the 1939 Annual Meeting, which will adjourn to Philadelphia. It was announced that the joint meeting with the Institution of Mechanical Engineers would, at the request of the British society, be devoted to the subject of transportation, and that the number of papers would be limited in order to allow time for sight-seeing and plant visits. It was decided that papers not devoted to the subject of transportation would be held over for presentation at later meetings.

At the afternoon session of the conference, the delegates were joined by those attending the local-sections conference for a discussion of common problems. It was brought out that the local sections need greater assistance from the professional divisions in building up their local programs. Professor Eaton, speaker of the local-sections conference, pointed out the fact that while the professional divisions are working out programs six months in advance, the local sections are frequently preparing for meetings to take place within six weeks. If a mechanism for securing aid from professional divisions were to be set up, the divisions would have to be notified well in advance of local-section needs. The fact was also brought out that the divisions would be glad to receive copies of good papers presented at local section meetings in order to consider recommending publication of them.

Mr. Hartford announced that each division would be asked to prepare a list of important activities that could be placed on local-sections programs, and a list of professional-divisions members, selected from different parts of the country, who would be willing to present technical papers at local-sections meetings. These lists are to be sent to the local sections, it is hoped, in April in order to allow more time for the preparation of next year's programs. Suggestions were made relating to assignments of professional-divisions men to local program committees.

Continuing its own deliberations after the joint session, the professional-divisions representatives discussed program-planning conferences. Mr. Gagg raised the question of building programs around some central theme, such as transportation in the coming joint meeting with The Institution of Mechanical Engineers, and asked the representatives to suggest themes for future meetings.

In discussing the subject of the stimulation of interest in the work of some of the smaller divisions, it was recommended that a survey of members be conducted in order to discover member interest. The opinion was expressed that the Society would be stronger if its activities were directed by committees made up of members serving voluntarily, and augmented by a staff to carry out routine matters. In order to work more effectively, each division should set up a number of committees in addition to its executive committee.

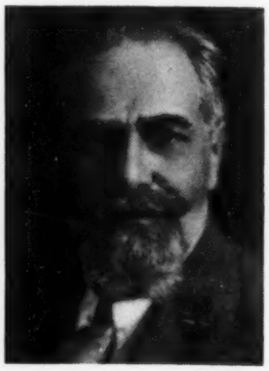
DESIGN COMMITTEE ORGANIZED

In a discussion of the possible need for additional divisions it was announced that a Design Committee had been organized, with Joseph Marin, assistant professor of engineering materials, Rutgers University, as chairman, and A. E. R. de Jonge, of the Babcock and Wilcox Company, New York, N. Y., as secretary.

V—HONORS NIGHT AN ENJOYABLE AFFAIR

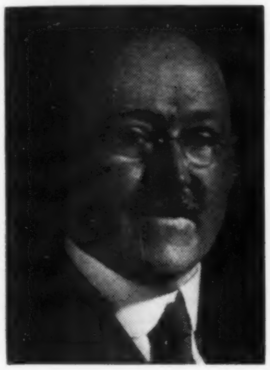
One of the pleasantest features of an A.S.M.E. Annual Meeting is Honors Night, the occasion on which the Society awards are bestowed, the incoming president is introduced, and, generally, an address of high quality is delivered. Every attempt is made to invest the exercises with simple dignity.

Honors Night at the 1938 Annual Meeting lived up to the best traditions of the occasion. On the platform were the president and secretary, flanked in a double row with the recipients of the awards and those designated to present them, and the Towne Lecturer, Gerard Swope, president of the General Electric Company. Three chairs were vacant, that on President Davis' left, and those at the extreme ends of the first row. After the tellers of the election of officers for 1938–1939 had re-




A. I. LIPETZ HARTE COOKE

(Dr. Lipetz was presented for Melville Medal by Mr. Cooke.)




L. P. ALFORD E. W. CONNOLLY E. W. O'BRIEN W. E. JOHNSON

(At Honors Night Mr. Connolly was presented for the Charles T. Main Award by Dr. Alford and Mr. Johnson for the Pi Tau Sigma Award by Mr. O'Brien.)

ported, from the audience, escorted by Chas. T. Main and D. S. Jacobus, senior past-presidents, came President-Elect A. G. Christie, of Johns Hopkins University. It was for these three that the vacant chairs had been arranged.

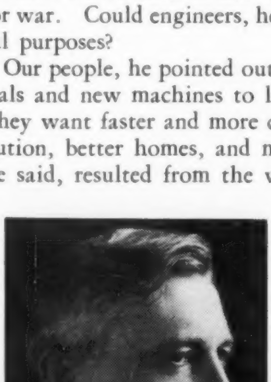
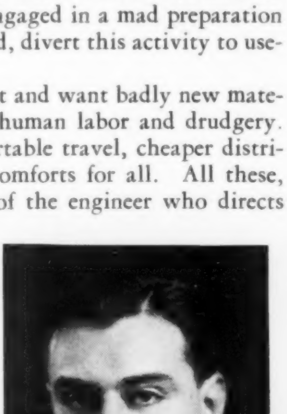
PRESIDENT-ELECT CHRISTIE OFFERS A CHALLENGE

In acknowledging the applause that greeted his introduction to the audience, Professor Christie said that some members of the Society thought that it was being run by professors. At his university, however, the complaint was that he spent half his time on engineering work. It was his belief, he continued, that a teacher must participate in engineering or he would find that the world passed by him and left him behind. As for himself, Professor Christie compromised on a fifty-fifty basis. In assuming the presidency of the Society he would, he said, find much to do, many places to visit, new acquaintances to make, and "lots of hard work."

Speaking as an engineer, he said that he considered the country to be on the threshold of a new industrial era. This was not the "New Deal," although the New Deal would leave its influences for years to come. But the whole world was becoming mechanized and industrialized. Tariffs and restrictions had raised artificial barriers to the free flow of commerce. Nations feared nations and were engaged in a mad preparation for war. Could engineers, he asked, divert this activity to useful purposes?

Our people, he pointed out, want and want badly new materials and new machines to lessen human labor and drudgery. They want faster and more comfortable travel, cheaper distribution, better homes, and more comforts for all. All these, he said, resulted from the work of the engineer who directs and controls the forces of nature for the use and benefit of mankind. Herein, he said, was the challenge to the mechanical engineer. Let America, he said, lead in creative engineering of new products, machines, and services. Let us, he continued, develop new ideas. Let us again assume the world's industrial leadership. Although others are mechanized, we should be like Kipling's old shipbuilder who said:

"They copied all they could follow,
But they couldn't copy my mind,
So I left them swearing and sweating
A year and a half behind."

W. H. CARRIER A. C. STERN

(Mr. Stern was presented by Mr. Carrier for the Junior Award.)

AWARDS CONFERRED WITH SIMPLE DIGNITY

The ceremony of conferring awards was simple and dignified. President Davis recognized each presenter of the recipients of awards, who came forward, accompanied by the man to be honored, and presented him with appropriate comment on the nature of the award and the receiver of it. The awards on the 1938 list were as follows:

Undergraduate Student Award; DONALD C. MCSORLEY, of Lansing, Mich., for his paper, "Humidity Insulation." Mr. Mc Sorley was presented by Huber O. Croft.

Postgraduate Student Award, MARSHALL C. LONG, of Princeton University, for his paper, "An Investigation Into the Angular Characteristics of an Adjustable-Blade Current Meter." Mr. Long was presented by F. V. Larkin.

Charles T. Main Award, to EDWARD W. CONNOLLY, of Detroit, Mich., for his paper, "Economic Limitations in Engineering Design, With Concrete Examples." Mr. Connolly was presented by L. P. Alford.

Junior Award, to ARTHUR C. STERN, of New York, N. Y., for his paper, "Separation and Emission of Cinders and Fly Ash." Mr. Stern was presented by Willis H. Carrier.

Pi Tau Sigma Award (given this year for the first time), to WILFRID E. JOHNSON, of Ft. Wayne, Ind., for outstanding achievement in mechanical engineering. Mr. Johnson was presented by Eugene W. O'Brien.

Melville Medal, to ALPHONSE I. LIPETZ, of Schenectady, N. Y., for his paper, "The Air Resistance of Railroad Equipment." Mr. Lipetz was presented by Harte Cooke.

Worcester Reed Warner Medal, to LAWFORD H. FRY, of Pittsburgh, Pa., for contributions relating to locomotive-boiler design and utilization of better materials in railway equipment. Mr. Fry was presented by Roy V. Wright.

Holley Medal, to FRANCIS HODGKINSON, of New York, N. Y., for meritorious services in the development of the steam turbine. Mr. Hodgkinson was presented by Geo. A. Orrok.

Honorary membership in The American Society of Mechani-

R. V. WRIGHT

L. H. FRY

FRANCIS HODGKINSON

GEO. A. ORROK

(At Honors Night Mr. Fry was presented by Dr. Wright for the Worcester Reed Warner Medal and Mr. Hodgkinson by Mr. Orrok for the Holley Medal.)

cal Engineers, to MAJOR-GENERAL WILLIAM H. TSCHAPPAT, retired, former chief of ordnance, U.S.A., now of East Falls Church, Va. General Tschappat was presented by Alex Dow.

Announcement was made of the award of the A.S.M.E. Medal to STEPHEN J. PIGOTT, Clydebank, Scotland, for outstanding leadership in marine propulsion and construction. Presentation of the medal will be made, it is hoped, at a joint meeting of the Society and The Institution of Mechanical Engineers, in September, 1939.

GERARD SWOPE DELIVERS THE TOWNE LECTURE

Following the conferring of the awards, President Davis introduced the 1938 Towne Lecturer, Gerard Swope, president of the General Electric Company, whose address was entitled, "Mechanical Engineering—Materials, Methods, and Men." Mr. Swope's address will be found on pages 5 to 7 of this issue.

VI—ANNUAL DINNER ENJOYED BY 800

Flanked with a group of distinguished persons at the speakers' table, among whom were President Harvey N. Davis, President-Elect A. G. Christie, the Thurston Lecturer, Dr. Howard W. Haggard, and past-presidents of the A.S.M.E., and officers of other engineering societies, W. L. Batt, himself a past-president, presided in the capacity of toastmaster at the 1938 Annual Dinner, held on December 7 in the ballroom of the Hotel Astor. Approximately 800 members and guests had assembled during a program of organ selections played by Leslie N. Leet, member of the Society, and had partaken of a satisfying meal and agreeable table conversation, when Mr. Batt arose and, in the easy manner that has won applause for him on many previous occasions, took charge of the not-too-long and very smoothly run after-dinner exercises, which were initiated with the singing of "The Star Spangled Banner," by Mrs. William A. Shoudy.

Mr. Batt's first duty was to present to the audience his companions at the long table on the dais. To President Davis fell the honor of calling the 1938 roll of "Fifty-Year Members of the A.S.M.E.," Charles W. Bray, Henry R. Cornelius, W. O. Hildreth, James C. Hobart, Henry Lipps, Jr., Percival Roberts, Newell Sanders, Henry H. Suplee, and William M. Taylor. Of these nine, Messrs. Cornelius and Hildreth were present to receive from the President the badges which indicate that the period of their Society membership has reached its fiftieth year. Following these presentations the forty-five-year, forty-year, and thirty-five-year members present arose in their places, amid applause, as their groups were called.

ADDRESSES SET HIGH MARK

The addresses presented in the hour that followed attained a high order of excellence, both in their substance and in their delivery. No little curiosity had been aroused by the titles announced for these addresses, for Dr. Davis had chosen "An Engineer's Philosophy" for his, and Dr. Haggard's had been announced as "Physiology for the Engineer."

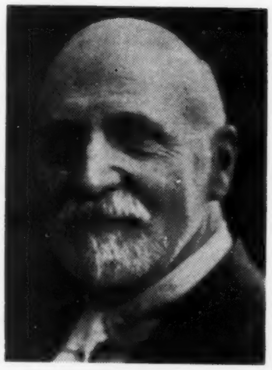
Dr. Davis' address showed the scholar at the height of his form, and created in his audience a desire to read it at leisure. In the Thurston lecture, which will be found elsewhere in this issue, Dr. Haggard used illumination and air conditioning as examples of engineering practice in which a knowledge of physiology is of great service to the engineer.

Following the addresses, Francis Hodgkinson, chairman of the Dinner Committee, invited everyone to attend the President's reception and to take part in the dancing. President and Mrs. Davis, President-Elect and Mrs. Christie, Dr. and Mrs. Haggard, and Secretary and Mrs. Davies greeted members and guests. Dancing, with exhibitions by professional dancers, continued until 2 a.m.

ALL-MEMBERS DINNER SPONSORED BY JUNIOR GROUP

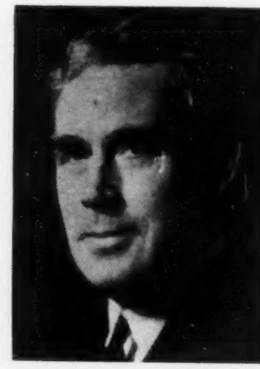
(Left to right, Henry B. Fernald, Jr., chairman, Metro Junior Group; H. L. Davis, guest speaker; W. W. Lawrence, toastmaster; and C. F. Scott, representing E.C.P.D.)

W. H. TSCHAPPAT



ALEX DOW

W. L. BATT

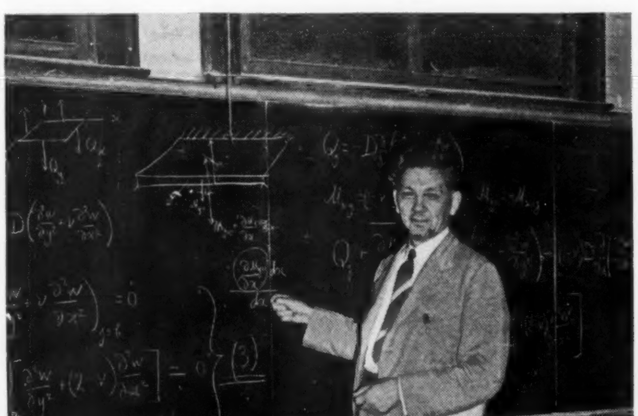


H. N. DAVIS

(At Honors Night at which Dr. Davis presided General Tschappat was presented by Dr. Dow, past-president A.S.M.E., for honorary membership in The American Society of Mechanical Engineers. Mr. Batt, also a past-president of the Society, acted as toastmaster at the Annual Dinner.)

VII—JUNIOR DINNER ATTENDED BY FIFTY SENIOR AND JUNIOR MEMBERS

With Walter W. Lawrence as toastmaster, the Annual Meeting All-Members Dinner on Monday evening, Dec. 5, 1938, at the Roger Smith Restaurant was attended by fifty senior and junior members of the A.S.M.E. from various parts of the country. The out-of-towners included C. F. Hildenbrand of Baltimore, H. C. Ashley of Waterbury, H. F. Ramm of New Britain, R. E. Matter of Boston, R. D. Moore of Columbus, A. P. Stern of Cleveland, D. F. Schick of Philadelphia, J. S. Woodward and E. R. Boynton of Albany, C. F. Scott of New Haven, A. D. Ruiz of Schenectady, R. S. Lynch and P. L. F. Feyling of Boston.



STEPHEN TIMOSHENKO

(A photograph taken of Dr. Timoshenko by J. C. Osborn during the summer of 1938.)

Talking on "The Young Engineer's Responsibility to Industry," the guest speaker of the evening, Howard Lee Davis, retired director of technical employment and training for the New York Telephone Company, stressed the need of the young engineer's "doing all he reasonably can to develop himself, not only technically, but, broadly, culturally. Industry needs more such live-wire and technically trained men."

In conclusion, Mr. Davis said, "E.C.P.D. working with and through A.S.M.E. and the other engineering societies, is making a major effort to guide and assist young engineers who desire broad development. Learn of its efforts to help you. Then do all you reasonably can to help yourself. This is your responsibility not only to industry but to yourself."

Prof. Charles F. Scott, formerly chairman of the E.C.P.D. and now president of the National Council of State Boards of Engineering Examiners, concurred in Mr. Davis' statements.

VIII—SIXTY-NINE TECHNICAL PAPERS READ AND DISCUSSED

To give even the briefest account of the many technical papers read at the 1938 Annual Meeting and to report the discussion on them would be a task beyond the capabilities of one man, who would, in order to do so, have had to split himself into several parts, as the crowded program necessitated simultaneous sessions on Monday evening, and on the mornings and afternoons of Tuesday, Wednesday, and Thursday. Space would not be available to record outlines of the 69 papers delivered at these sessions. Fortunately, many of the papers have been published in MECHANICAL ENGINEERING, and preprints of 32 other papers, that will appear, complete with discussion and author's closure, in the 1939 Transactions, were available at the meeting. A program of technical sessions was published in MECHANICAL ENGINEERING for November, 1938. Large attendance and ample discussion were characteristics of many of the sessions.

IX—TIMOSHENKO HONORED BY APPLIED MECHANICS DIVISION

One of the pleasantest events of the 1938 Annual Meeting was the annual dinner of the Applied Mechanics Division at which Stephen Timoshenko, one of the founders of the division, was honored. To John M. Lessells, editor of the *Journal of Applied Mechanics*, we are indebted for the following account of the dinner:

The annual dinner of the Applied Mechanics Division was held at the Midston House, Dec. 6, 1938, at 6:30 p.m. Since during this month occurred the sixtieth birthday of Prof. S. Timoshenko, one of the founder

DR. HARVEY N. DAVIS, PRESIDENT OF THE SOCIETY, GIVING BITS OF ADVICE TO THE STUDENTS AND MEMBERS AT THE STUDENT LUNCHEON ON WEDNESDAY, DEC. 7, DURING THE ANNUAL MEETING IN NEW YORK

members of the division, the dinner took the form of a special function to honor this distinguished scientist engineer.

Prof. J. M. Lessells, of the Massachusetts Institute of Technology, acted as toastmaster and in a brief introduction stressed the genius which Timoshenko had exhibited in giving inspiration to all those who had worked with him. He also emphasized that Wren's famous inscription in St. Paul's Cathedral, "Si monumentum requiris, circumspice" (if you would see his monument, look about you) could very well be the theme for the evening's program.

In the development of this theme, various periods of Timoshenko's work in the field of mechanics were discussed. Prof. C. R. Soderberg, chairman of the Applied Mechanics Division, spoke of the part Timoshenko had played in the creation of the division, and conveyed to Timoshenko the greetings of the Society, acquainting him also with the fact that he had been elected to the grade of Fellow in the Society.

Prof. G. B. Karelitz, of Columbia University, then spoke of the Russian period prior to the Revolution of 1917 and stressed how much Timoshenko had contributed to the teaching of mechanics in his native land. He also read several of the many cablegrams of greetings which had been sent to Timoshenko from different European countries offering heartiest congratulations on this birthday celebration. Professor Bakhmeteff, of Columbia University, a school friend of Timoshenko, also made some interesting remarks on his early association with Timoshenko in Russia.

R. E. Peterson, of the Westinghouse Research Laboratories, spoke on Timoshenko's contribution to industry and brought still more greetings from his Westinghouse friends.

Prof. J. P. Den Hartog, of Harvard University, who was the first pupil of Timoshenko during the Westinghouse period, referred to his early work with him, and Prof. E. L. Eriksen, of the University of Michigan, referred to the great part played by Timoshenko in forming the Division of Engineering Mechanics at Michigan, and its many students who came from all parts to study under him in graduate work.

Pleasant interludes occurred in which Timoshenko was given a bottle of Tokay wine obtained in Hungary by Dr. Hetényi and brought to this country for the occasion, the vintage year of the wine being the same as that of Timoshenko's birth. A photograph showing Timoshenko lecturing to a class at Michigan (see page 51) was presented to the Society by Prof. J. Ormondroyd, with the suggestion that it be hung in a suitable place in the headquarters building.

The high point of the evening came when the toastmaster called on H. B. McCurdy, a representative of the Macmillan Company, who presented a volume entitled "Contributions to the Mechanics of Solids," and especially dedicated to Timoshenko. This book contains papers on this subject from twenty-nine scientists and engineers of international repute who have either worked with Timoshenko or have been associated with him. The special presentation de luxe volume also contained the actual autographs of each author.

Subsequent to the presentation of this commemorative volume, Professor Timoshenko made a suitable reply and thanked his friends for their great appreciation.

Much interest was shown in the printed program of the dinner, which, by the aid of sketches and border drawings, illustrated various aspects of Timoshenko's work in mechanics. These programs were prepared by L. M. Tichvinsky, of the Westinghouse Company.

X—FIFTY-ONE TECHNICAL COMMITTEE MEETINGS HELD

Coincident with the technical sessions the usual large number of technical committee meetings was held. These meetings extended from early Monday morning to late Friday afternoon and numbered 51 in all; Research 10, Standards 22, Power Test Codes 10, Safety 7, Boiler Code 2. The total attendance at these meetings was 718.

The A.S.M.E. Research Committee opened the meetings of the week with its dinner meeting held at the Engineers' Club on Monday evening. The officers of the 23 special and joint research committees and the members of the A.S.M.E. Council had been invited to attend this general dinner meeting and thirty sat down at 6:15. When the meal was over chairman N. E. Funk presided and first introduced the other members of the Research Committee present, L. W. Wallace and E. G. Bailey. H. A. Johnson was not able to attend and J. E. Gleason had found it necessary to resign from the committee during the last year.

The presiding officer next introduced W. Trinks and M. D. Hersey the newly appointed members of the committee. He then greeted the four advisory members of the main committee, Albert Kingsbury, R. J. S. Pigott, A. A. Potter, and A. E. White; members of the Council, Harte Cooke, K. H. Condit, F. O. Hoagland, Clarke Freeman, Alfred Iddles, W. H. McBryde, and H. H. Snelling; and two representatives of The Engineering Foundation, F. M. Farmer, chairman, and O. E. Hovey, director.

The other guests present were then requested to introduce themselves and to make a brief report on the progress made by their special research committees during the year just closed. Thirteen committees were heard from in this way and the reports indicated that a considerable amount of progress had been made by them. At the close of this round robin the Research Committee went into executive session and the others present withdrew to attend the technical sessions which were scheduled for that evening.

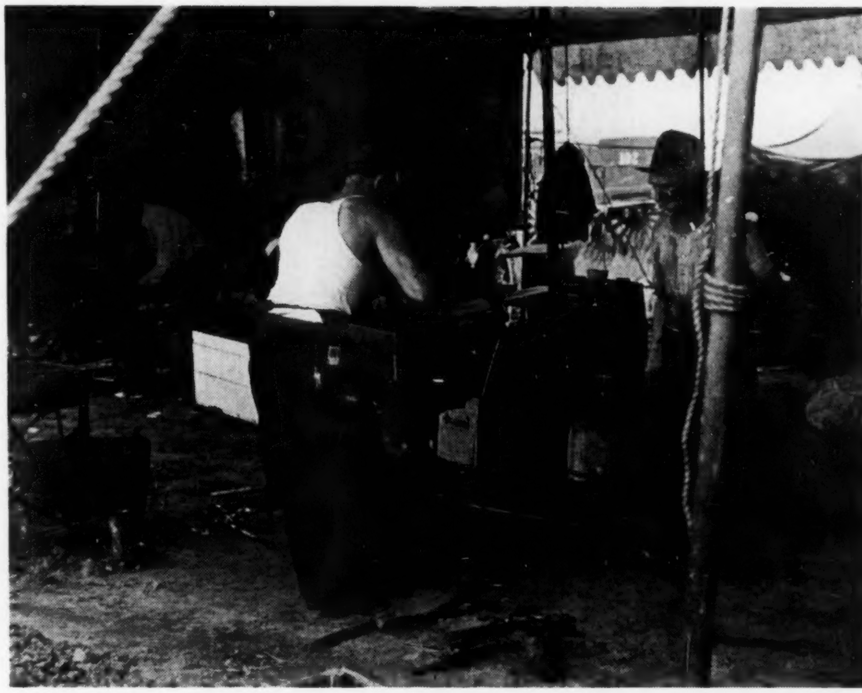
The first item of importance on the agenda was the election of the chairman for the coming year. Mr. Funk expressed a desire to retire but at the unanimous request of the other members of the committee he consented to serve as chairman for the last year of his term on the committee.

The following three special committees which had reported the completion of their work and the desire to be discharged were granted their wish with the appreciation and the thanks of the main committee: Removal of Ash as Molten Slag From Powdered Coal Furnaces, K. M. Irwin, chairman; Sampling Pulverized Fuel in a Moving Gas Stream, K. M. Irwin, chairman; and Heavy-Duty Antifriction Bearings, W. Trinks, chairman.

The secretary reported the completion and publication during the year of "Creep Data," a compilation of available high-temperature creep characteristics of metals and alloys by the Joint Research Committee on Effect of Temperature on the Properties of Metals and the final editing of the "Manual on Cutting of Metals," by the Research Committee on Metal Cutting Data. The former was published in October, 1938, and the latter will be issued early next spring.

Nine special and joint research committee meetings were held during the five days of Annual Meeting week. They were all well attended and in each case good progress was recorded. On Monday and Tuesday, however, no meetings were held and the time was given over to the technical sessions.

At the session on thermodynamics, Monday evening, two members of the Special Research Committee on the Thermal Properties of Steam presented papers, J. H. Keenan on "Friction Coefficients for the Compressible Flow of Steam," and N. S. Osborne, assisted by H. F. Stimson and D. C. Ginnings, on "New Measurements of the Specific Heats of Water and the Mechanical Equivalent of Heat."



"CIRCUS BLACKSMITH"

(Photograph by H. K. W. Viohl shown at the Photographic Exhibit of the 1938 A.S.M.E. Annual Meeting.)

On the following day, Tuesday, four of the A.S.M.E. special research committees took major parts in the technical sessions. At the session on pipe-stress problems sponsored jointly by the Applied Mechanics Division, the Power Division, and the Joint Research Committee on Effect of Temperature on the Properties of Metals, progress reports on "Creep Tests on Tubular Members," by F. H. Norton and on "Relaxation Tests," by E. L. Robinson were made.

In the afternoon, C. H. Fellows, chairman of the Joint Research Committee on Boiler Feedwater Studies, made a report at the Power-Fuels session in which he summarized the progress made so far by the subcommittees of his committee which are investigating coagulation and sedimentation, patents, and effect of solution composition on the cracking of boiler metal.

Coincident with this session the Special Research Committee on Cutting of Metals joined with the Machine Shop Practice Division in sponsoring a session at which O. W. Boston, W. W. Gilbert, and L. V. Colwell presented a paper entitled "Effects of Size and Shape of Cut Upon the Performance of Cutting Fluids When Turning S.A.E. 3140 Steel." Erik Oberg presided at this session and G. E. Leavitt, Jr., was the recorder.

Two sessions on elasticity were sponsored during the week jointly by the Special Research Committee on Mechanical Springs and the Applied Mechanics Division. The first was held on Tuesday afternoon at which three papers were presented, "Stresses in Helical Compression Springs—Present Status of the Problem," by C. T. Edgerton, secretary of the committee; "Analysis of Effect of Wire Curvature on Allowable Stresses in Helical Springs," by A. M. Wahl, and "A Method of Calculating Energy Losses During Impact," by C. Zener and H. Feshbach. Prof. S. Timoshenko presided and Prof. G. B. Karelitz served as recorder. The second session was held on Wednesday afternoon. Chairman J. R. Townsend presided at this session and Secretary C. T. Edgerton acted as recorder. The three papers assigned to this session were presented in the following order: "Deflection of Helical Springs Under Transverse Loadings," by W. E. Burdick, F. S. Chaplin, and W. L. Sheppard; "Strength of Metals, With Special Reference to Spring Materials," by D. J. McAdam, Jr., and "Research Report on Helical Springs," by C. T. Edgerton. That morning the Special Research Committee on Mechanical Springs held its annual meeting with twelve present.

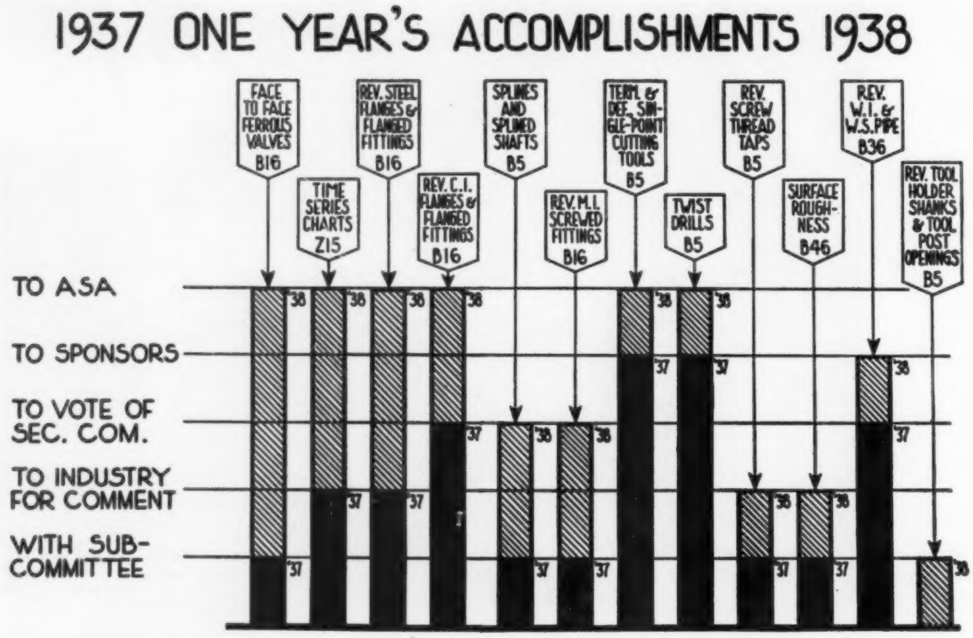
The meeting of the Joint Research Committee on Boiler Feedwater Studies Executive Committee, C. H. Fellows, chairman, held on Wednesday morning was given over to business. Ten were present. The subcommittee on effect of solution composition on the cracking of boiler metal, J. H. Walker, chairman, met in the afternoon and discussed the details of its research program.

Thursday was fluid-meters day. The special research committee sponsored a technical session in the morning which was well attended. Chairman R. J. S. Pigott presided and M. J. Zucrow served as recorder. Six papers and reports were presented at this session and it is reported that this session closed on time. The papers were "Influence of Steam-Flow Metering Equipment on Piping Design," by R. M. Van Duzer, Jr., "Effect of High Temperatures and Pressures on Cast-Steel Venturi Tubes," by W. S. Pardoe, "Coefficients of Orifices and Nozzles With Free and Also Submerged Discharge," by R. G. Folsom, "Effect of Pulsations on Orifice Meters," by S. R. Beitler, "Review of Flow-Nozzle Research With Oil," by Edgar E. Ambrosius, and "Pulsating Air Velocity Measurement," by Neil P. Bailey.

Twenty attended the regular Annual Meeting of the Special Research Committee on Fluid Meters Thursday afternoon. Plans were laid for the proposed research on the volume meter.

At the meeting of the Special Research Committee on Critical-Pressure Steam Boilers, Chairman A. A. Potter discussed with the eight members of his committee who were present the plans for the comparative oxidation tests on the alloy steels about to be undertaken at Purdue University.

One new special research committee held its organization meeting. This committee is to study the rolling of steel. Dr.



SHOWING ONE YEAR'S ACCOMPLISHMENTS IN THE DEVELOPMENT OF TWELVE STANDARDS

A. Nádai is the moving spirit in this new project which has already secured $4000 to cover the first year's expenses. M. J. Manjoine has been engaged as the research fellow at the University of Pittsburgh.

Two luncheon meetings were held at the Engineers' Club on Wednesday noon, one by the Special Research Committee on Condenser Tubes, A. E. White, chairman, and Bert Houghton, vice-chairman. Forty three were present. The second was a joint luncheon meeting of the special research committees on cutting of metals, M. F. Judkins, chairman, and metal cutting fluids, O. W. Boston, chairman.

STANDARDS COMMITTEES REPORT PROGRESS

The annual A.S.M.E. standards luncheon came this year on Thursday noon toward the end of a busy week of 22 standards committee meetings. Forty-one (41) chairmen and secretaries of standards committee meetings attended.

Walter Samans, chairman of the A.S.M.E. Standardization Committee, presided. He first introduced the members of his committee, O. A. Leutwiler, W. C. Mueller, A. L. Baker, and J. E. Lovely. Then the guests of honor were presented: Dr. C. P. Bliss, A. M. Houser, Alfred Iddles, and C. W. Spicer, advisory members of the committee, and Dr. P. G. Agnew, secretary of the American Standards Association, and Cyril Ainsworth, assistant secretary, A.S.A.

The usual round of self-introductions then took place when each person present in addition to identifying himself and the committee on which he is serving was asked to tell in a few words the progress which his group had made during the year. Then C. B. LePage, secretary of the committee, was called upon by the chairman for his report. In response, he stated that six standards had been completed and submitted to the A.S.A. for approval. In addition, he displayed a bar chart (see accompanying illustration) which showed that good progress had been made toward the completion of six other standards.

Prior to the luncheon the A.S.M.E. Standardization Committee held its annual meeting. All five of its members were present and in addition two of its former members, Alfred Iddles and C. W. Spicer. The first order of business was the election of the chairman for the coming year and Prof. O. A. Leutwiler was unanimously elected.

The committee spent considerable time in preparing nominations for President Christie of members who are to represent the Society on a number of sectional committees. Consideration was then given to certain controversial subjects concerning which Alfred Iddles, the A.S.M.E. representative on the A.S.A. Standards Council and the Mechanical Standards Committee, desired to have the advice of this committee.

Two new standards projects were presented and discussed at some length and two members of the committee agreed to make further studies of these projects and to report their findings to the secretary.

The first standards committee meeting of the week was held on Monday morning by the subgroup on socket welding fittings of B16. Sabin Crocker presided and thirteen members of the group and guests were present.

Seventeen assembled in the afternoon for the meeting of the subcommittee of B31 on power piping, Alfred Iddles, chairman, and excellent progress was shown toward the completion of the revision of this chapter of the Code for Pressure Piping.

The annual meeting of B31 followed the next day and, as usual, was attended by the greatest number. Sixty eight were present and took part in the discussions prompted by the reports of the nine subcommittees engaged in revising the several chapters of the Code for Pressure Piping. E. B. Ricketts, chairman, presided.

Two other standards committee meetings which were well-attended were those of the sectional committee on allowances and tolerances for cylindrical parts and limit gages, B4, J. E. Lovely, chairman, and the sectional committee on screw threads, B1, R. E. Flanders, chairman.

Thirty-five attended the meeting of committee B4 where a lively discussion centered on the form the proposed revision of the American Standard for tolerances, allowances, and gages for metal fits should take. It was finally agreed that a translation of the I.S.A. system of fits as given in the final report of I.S.A. Technical Committee 3 on fits should be made with the values converted to inches. It was decided to ask the National Bureau of Standards to make an estimate of the cost involved in such a translation. It was further agreed to prepare a modification of the I.S.A. system of fits somewhat along the lines indicated in proposals prepared earlier by three members of the committee, but where the values would be rounded to even inches. The committee plans then to present both proposals to American industry for criticism and comment in order to determine which system is preferred in this country.

Forty attended the four-hour session of sectional committee B1 on standardization and unification of screw threads at which Chairman R. E. Flanders presided. The principal subject of discussion was the report of subcommittee No. 5 on screw thread gages and inspection, Geo. S. Case, chairman. After a full discussion and with the aid of a special subcommittee, resolutions were drafted recommending (1) the use of class 1 nuts and class 2 screws where the average commercial

fit in the product is desired and (2) the addition to the standard of a classification with an allowance and a tolerance wider than that of class 1. It was suggested at the meeting also that the section on screw-thread gaging cover in some detail the screw-thread requirements from the user's point of view.

The sectional committee on classification and designation of surface qualities, B46, J. R. Weaver, chairman, comes next in order of attendance. Eight attended its executive committee meeting which was held on Tuesday morning and 33 the meeting of the sectional committee held on Thursday morning. One result of these meetings is the release of a proposed American Standard for surface roughness to the members of the committee for vote on approval by letter ballot.

Eight meetings were held by the group of twenty committees, B5, engaged in setting up standards for small tools and machine-tool elements headed by W. C. Mueller. The first, which was scheduled for Tuesday morning, dealt with designations and working ranges of machine tools and was presided over by John Haydock, the chairman of the technical committee. During the same period the technical committee on forming tools and holders held its meeting. W. C. Mueller is chairman of this committee. On Tuesday morning also Prof. O. W. Boston held meetings of the technical committees on tool posts and holders and on nomenclature of small tools of which he is chairman.

"A DAM FAILURE"

(Photograph by W. B. Updegraff shown at the Photographic Exhibit of the 1938 A.S.M.E. Annual Meeting.)

The finally revised draft of the proposed American Standard for involute splines and splined shafts was completed at a meeting of technical committee No. 13 which was held on Wednesday morning, under the chairmanship of C. W. Spicer. Six members of the committee were present. On the afternoon of the same day technical committee No. 8 on jig bushings, F. S. Walters, chairman, held a meeting.

On Thursday morning a well-attended joint meeting of technical committee No. 3 on machine tapers and committee No. 4 on spindle noses and collets was held. In the absence of chairman F. S. Blackall, Jr., on a trip to Europe, B. P. Graves acted as chairman of No. 3 and chairman J. E. Lovely represented committee No. 4.

That afternoon an executive session of sectional committee B5 on the standardization of small tools and machine-tool elements was held to receive the annual reports of these and the other technical committees of this group. W. C. Mueller presided in his capacity as chairman of the committee.

The American Gage Design Committee also held its annual meeting during this week of meetings. Col. J. O. Johnson presided and twenty were present.

POWER TEST CODES

Ten meetings of committees of this group were held during the week. Committee No. 3 on fuels, W. J. Wohlenberg, chairman, opened the series with its meeting on Monday afternoon at which it discussed the final editing of the proposed new Test Code for Gaseous Fuels.

The following Tuesday morning, committee No. 6 on steam turbines, C. H. Berry, chairman, met for breakfast at the Engineers' Club. Fourteen were present and they spent five hours reviewing the comments which had been received on the May, 1938, draft of the revised code. The finishing touches on this code will now be added by a special subcommittee consisting of C. Harold Berry, W. E. Caldwell, and Francis Hodgkinson.

That same afternoon nine attended the meeting of committee No. 8 on centrifugal and rotary pumps held in the board room of the American Society of Refrigerating Engineers next door. M. B. MacNeille, chairman, presided and led the committee through a detailed study of the March, 1938, draft of the proposed revision of this code. Before the meeting adjourned each member of the committee was assigned a particular part of the code for further study and development.

Three committees met on Wednesday morning. Committee No. 2 on definitions and values, R. J. S. Pigott, chairman; committee No. 11 on complete steam-power plants, F. M. Van Deventer, chairman; and committee No. 21 on dust-separating apparatus, M. D. Engle, chairman. All three of these committee meetings were well-attended. The first recorded good progress toward a thorough revision of the present Code on Definitions and Values. The second, by meeting in an adjourned session the following day, practically completed the review of the comments it had received to a tentative draft previously distributed to industry. The third had an attendance of twelve who discussed at length the criticisms and comments which had resulted from the distribution of a tentative draft of the proposed code on dust-separating apparatus in July, 1938.

While the revised Test Code for Hydraulic Prime Movers was approved and published in July, 1938, committee No. 18 met Thursday morning to elect a new chairman in the place of E. C. Hutchinson, who found it necessary to resign early in the fall, and to lay plans for the development of the supplementary material which is to form the supplement or appendix to the code. Eight members of the committee were present and

S. Logan Kerr was elected to the chairmanship of the committee.

Thursday afternoon two additional committees held well-attended meetings. At the meeting of committee No. 4 on stationary steam-generating units, E. R. Fish, chairman, led his committee through a detailed study of a revised draft of this code which had been prepared by one of its members. He reports that all of the members of this enlarged committee have been active during the last year.

The second committee to meet in this same afternoon was that on fans, No. 10, M. C. Stuart, chairman. This committee also had distributed a tentative draft of its new code on the testing of fans in April, 1938, so much of the time of the meeting was spent in reviewing the criticisms and comments received and in arranging for a reediting of the code in line with the suggestions which the committee found it possible to accept. At this meeting the pitot-tube method of measuring air was unanimously accepted as the standard method in these performance tests.

Forty attended the meeting of the main committee which was held this year in the board room of the American Institute of Mining and Metallurgical Engineers. Francis Hodgkinson was in the chair and items of routine business were transacted.

Early in the meeting the chairman reported that the U. S. National Committee of the I.E.C. had agreed to invite certain advisory committees of the I.E.C. to hold meetings in New York during September, 1939. The committees now on the list are (1) rating of electrical machinery, (2) hydraulic turbines, (3) switchgear, (4) internal-combustion engines, (5) electric welding, and (6) insulation coordination.

All of the eleven individual committees which are now at work on new test codes or the revisions of old ones were represented and presented reports. Some of these reports presented by committees which had held meetings during the week have been summarized in the preceding paragraphs. However, in addition it should be stated that committee No. 9 on displacement compressors and blowers, Paul Diserens, chairman, has completed its revision of this important test code. C. B. LePage reported that on November 18, 1938, he had mailed finally revised proofs of his code to the members of the main committee for review prior to this meeting. As a consequence the committee was ready without extended discussion to order this code to letter-ballot vote of the Council.

When the report of committee No. 19 on instruments and apparatus was called for, W. A. Carter stated for C. F. Hirshfeld, chairman, that part 8, measurement of indicated horsepower, was being prepared for submission to the main committee for approval. The revised preliminary draft of part 7, measurement of power (by means of dynamometers) is to be completed and will be available shortly for criticism by the members of committee No. 19. As soon as the material on the high-velocity thermocouple is completed, part 3, chapter 3 on thermocouple thermometers will be submitted to the main committee for approval.

Mr. Carter then reported for the subcommittee on the measurement of fluid flow, of which he is chairman, that under date of November 25, proofs of the proposed report on flow measurement by means of standardized nozzles and orifice plates were mailed to the members of the main committee for study. Final approval was ordered by the main committee.

SAFETY AND HYGIENE CODIFICATION

The largest number of safety-committee meetings to be scheduled for many a year during an Annual Meeting set a record for this year. Two of these committees met for the entire day of seven hours.

The first of the all-day meetings was that of subcommittee No. 1 on all types of chain conveyers, belt conveyers, belt elevators, including steel belt, and screw, track, or scraper conveyers of sectional committee B20. C. G. Pfeiffer is chairman of this committee and under his leadership this section of the proposed American Standard safety code for conveyers and conveying machinery was practically completed.

The second all-day meeting was that of the sectional committee on a safety code for cranes, derricks, and hoists, J. C. Wheat, chairman. In the absence of Chairman Wheat, R. H. White presided in a very effective manner. This committee had held a similar meeting in October and at both of these meetings had devoted the time to a review of the comments which had been received as a result of the general distribution of a tentative draft of the proposed American Standard safety code for cranes, derricks, and hoists.

After a long period of inactivity during which the American Standard safety code for mechanical-power-transmission apparatus has been in general use in industry, sectional committee B15, G. M. Naylor, acting chairman, met to review the present status of the code and to lay plans for its revision and extension. The committee decided to begin this revision immediately.

In addition three subcommittees held half-day sessions. These were the subcommittee on jacks of sectional committee B30, E. W. Caruthers, chairman; subcommittee No. 5 on tiering, piling, and stacking conveyers of sectional committee B20, J. G. Wheatley, chairman; and subcommittee No. 4 on air, steam, or liquid conveyers of sectional committee B20, J. J. McNulta, chairman.

The Annual luncheon meeting of the A.S.M.E. Safety Committee was scheduled this year for Wednesday noon. Four of its five members, J. B. Chalmers, H. L. Miner, D. L. Royer, and T. F. Hatch were present. D. L. Royer was elected to the chairmanship for the coming year, and a number of items of routine business were transacted. Secretary LePage announced the appointment of Arthur E. Windle as the new member of the committee for the five-year term beginning December, 1938.

The Safety Session held Thursday morning under the auspices of the Safety Committee at which D. L. Royer, a member of the committee, presided, is discussed in another section of this report of the annual meeting. At this session a paper on "Control of Dust Explosions in Industrial Plants," by Hylton R. Brown and another on "Factory Layout and Safety," by F. J. Van Poppelen were presented.

BOILER CODE

As in previous years the Boiler Code Committee held its regular meeting on the Friday previous to the Annual Meeting week. However, two of its subcommittees took advantage of the presence of a large number of their members in New York during this week. The committee on feedwater, C. W. Rice, chairman, held its meeting Monday morning at which nine were present.

The second committee, that on rules for bolted flanged connections, met all day Friday. D. B. Wesstrom, chairman of the committee, presided and ten members of the committee were present.

XI—INSPECTION TRIPS, SIGHT-SEEING, AND ENTERTAINMENT

A comprehensive program of plant visits, sight-seeing, and entertainment was arranged this year by the Plant Visits and Entertainment Committee through the American Express Company, whose representative at the Engineering Societies Building took care of all reservations and the scheduling of bus departures. The use of an outside agency for this phase of the Annual Meeting, tried for the first time this year, worked out

very well according to the 600 or more who took advantage of this arrangement.

The grand tour of New York by day and also by night proved most interesting to those in New York for the first time. More than 130 took the several guided preview tours of the New York World's Fair. The inspection trips to the Essex generating station in Newark, N. J., the Waterside station in New York City, and the Williamsburg power plant in Brooklyn, were taken by over 200 members. For the oil and gas-power engineers, a special visit was arranged to the Diesel plant of the B. Altman department store. The machine-shop people visited the Brooklyn plant of the American Machine and Foundry Company. After the Honors Night session, 67 members and their wives had supper at the International Casino where they saw a special continental revue. Another entertainment feature of the same type was the dinner party on Thursday at the Casa Manana, which was attended by 40. Seventy Annual Meeting registrants were interested in visiting during the week Rockefeller Center, the N.B.C. broadcasting and television studios, the Empire State Building tower, and the New York Museum of Science and Industry.

XII—MANY COLLEGE ALUMNI REUNIONS HELD

Traditionally, Thursday of the Annual Meeting week provides opportunity for reunion luncheons, dinners, and smokers, of the alumini of several engineering colleges. Twenty-three such reunions were scheduled on the 1938 program. All of these were held on Thursday except that of the University of Pittsburgh, which was held on Sunday, Bucknell University and the University of Michigan, which were held on Tuesday, and Yale University, which was held on Friday. A variety of entertainment had been announced. Some alumni listened to addresses by members of their university faculties, some smoked, sang, drank beer, or witnessed vaudeville acts, while others frankly reverted to the first interest of the alumnus and let their university coaches tell them about the football season.

XIII—PHOTOGRAPHIC AND LIBRARY EXHIBITS ATTRACT MANY MEMBERS

Throughout Annual Meeting week two exhibits were in progress and attracted many members. On the north lobby of the fourth floor of the Engineering Societies Building the Third Annual National Photographic Exhibit, under the sponsorship of the A.S.M.E. Photographic Group, brought together many excellent examples of photographic art. Through the courtesy of the Group and the owners of the photographs, several of the pictures that appealed to the editors have been reproduced in this issue.

In the Engineering Societies Library, Harrison W. Craver, director, arranged a special exhibit covering books and periodicals mentioned in the bibliographies of several of the engineering papers presented during the meeting. There were also displayed examples of engineering literature published hundreds of years ago, together with some of recent times. Over a thousand visitors to the library examined its 141,000 volumes, 7000 maps, and 4000 bibliographies, the periodical index of 225,000 references to important engineering articles, samples of photostatic work, and early engineering drawings.

XIV—A.S.M.E. WOMAN'S AUXILIARY ACTS AS HOSTESS

Among its many activities, the A.S.M.E. Woman's Auxiliary acts as hostess to women in attendance at Annual Meetings. With its own program, it seeks to provide entertainment at times when the Society program offers little or nothing of interest to women. Its officers and committee, through Miss Burtie Haar, chairman of its publicity committee, have provided the following account of its activities during the 1938 Annual Meeting.

MISS HAAR REPORTS FOR THE AUXILIARY

The fifteenth anniversary celebration of the Woman's Auxiliary was opened on Monday, December 5, by Mrs. R. B. Purdy, acting for Mrs. J. Ansel Brooks, general chairman, with registration at the women's headquarters, in charge of Mrs. C. H. Young, chairman of registration. In the evening with Mrs. F. M. Gibson, chairman of hostesses, an informal gathering with music, cards, and tall stories was enjoyed and later the group visited a broadcasting studio to hear an excellent program.

Tuesday morning at the Engineering Societies Building, the Annual Meeting was convened. The officers for 1939 are: President, Mrs. George W. Farny; first vice-president, Mrs. J. H. R. Arms; second vice-president, Mrs. E. C. Stahl; third vice-president, Mrs. R. B. Purdy; fourth vice-president, Mrs. Coleman Sellers, 3d, of Philadelphia; fifth vice-president, Mrs. Harry A. Schwartz, of Cleveland; recording secretary, Mrs. C. E. Gus; corresponding secretary, Mrs. P. E. Frank; treasurer, Mrs. A. H. Morgan.

This fifteenth anniversary of the organization of the Auxiliary by the late Calvin W. Rice was celebrated by the establishment of a Calvin Winsor Rice Scholarship Fund with $250 as the Auxiliary's contribution to it. It is hoped that other contributions will augment the fund quickly so that it may function promptly.

During the last year, under Mrs. Farny's leadership, three new sections were added to the Auxiliary. Mrs. T. F. Githens, of Cleveland, Mrs. Coleman Sellers, 3d, of Philadelphia, and Mrs. D. E. Donovan, of Baltimore, gave excellent reports from their sections and members from different cities told of their efforts to form groups. Mrs. W. H. Carrier spoke for Syracuse, Mrs. W. B. Jackson for Worcester, Mrs. Paul Thompson for Detroit, Mrs. W. N. Flanagan for Pittsburgh, Mrs. R. S. Brown for New Britain, and Mrs. F. O. Hoagland for Hartford. It was a very enthusiastic meeting which Mr. R. F. Gagg, one of the advisers to our Auxiliary greeted. Before adjournment, the Auxiliary was happy to make Mrs. Calvin W. Rice an honorary member. Thirty-two years ago when Mr. Rice assumed the secretaryship of the Society Mrs. Rice joined with him in real loyalty and unselfish service to both the Society and the Auxiliary.

The Anniversary luncheon was held in the Cafe Louis IV at Rockefeller Center. The toastmistress, Dr. Lillian Gilbreth, introduced the president, Mrs. Farny, who after her own greeting to the Auxiliary, introduced Mr. James H. Herron, past-president of the Society. Mr. Herron suggested a new opportunity for service in aiding college graduates to become junior members of the Society. He also suggested that the ladies provide more social affairs for the engineer and his family. Dr. Gilbreth next introduced Mrs. R. V. Wright, chairman of the Educational Fund, who summarized her annual report and said that, as the result of the Fund's loans to students, an alumni association had been formed at Newark College of Engineering and had started its own Fund to aid its own students. Mrs. Harvey N. Davis, wife of the retiring president of the Society, spoke of the change in ideas regarding the suitability of women's activities of the present. To Mrs. A. D. Blake, chairman of the Anniversary Luncheon Committee and her aides the Auxiliary is indebted for an enjoyable luncheon served in a most attractive setting. Later the entire group went to the exhibition of Television in Radio City.

On Tuesday evening many of the ladies dined at The Engineering Woman's Club. The chairman for the informal dinner was Mrs. G. L. Knight. Later the party attended Honors Night at the Engineering Societies Building.

Wednesday morning the Auxiliary joined with the members of the Society in a trip to the World's Fair grounds. After luncheon at the Terrace Club, the Bache Museum was visited. In the evening at the Annual Dinner and President's Reception at the Hotel Astor, the Auxiliary was greatly pleased when the toastmaster, W. L. Batt, publicly thanked the Auxiliary's president, Mrs. Farny, for assistance given the Society.

Thursday morning at the Engineering Woman's Club, there was an interesting demonstration of accessories by Mrs. Douglass James, of Lord & Taylor's, and in the afternoon, before the annual tea, Mrs. A. M. Feldman, chairman of excursions, with her illuminating comments, made the trip to the Cloisters very enjoyable. Mrs. R. V. Wright was

chairman of the annual tea which completed the fifteenth Annual Meeting of the Woman's Auxiliary.

XV—THESE PLANNED IT ALL

Meetings of The American Society of Mechanical Engineers are held under the general sponsorship of the Committee on Meetings and Program. The technical sessions are arranged by the Committee on Professional Divisions, the executive committees of the divisions, and certain other committees whose work results in papers on reports publicly presented. In addition to these groups, a number of special committees consisting of members located in the Metropolitan area take charge of most of the necessary local arrangements.

Clarke Freeman served as chairman of the Committee on Meetings and Program, and with him were R. F. Gagg, A. L. Kimball, Erik Oberg, W. J. Wohlenberg, W. W. Lawrence, and H. G. Oliver, Jr. The chairman of the Committee on Professional Divisions was L. K. Sillcox.

The local committees assisting in the conduct of the meeting were as follows:

RECEPTION: W. M. C. McKee, chairman, Howard Butt, H. S. Colby, J. C. Falkner, John Fardelmann, R. D. Foltz, W. S. Johnson, Robert Jory, C. B. Karlson, J. F. Keeler, W. M. Keenan, W. F. Leggo, H. E. Martin, W. L. McHale, L. W. Nones, and H. Weisberg.

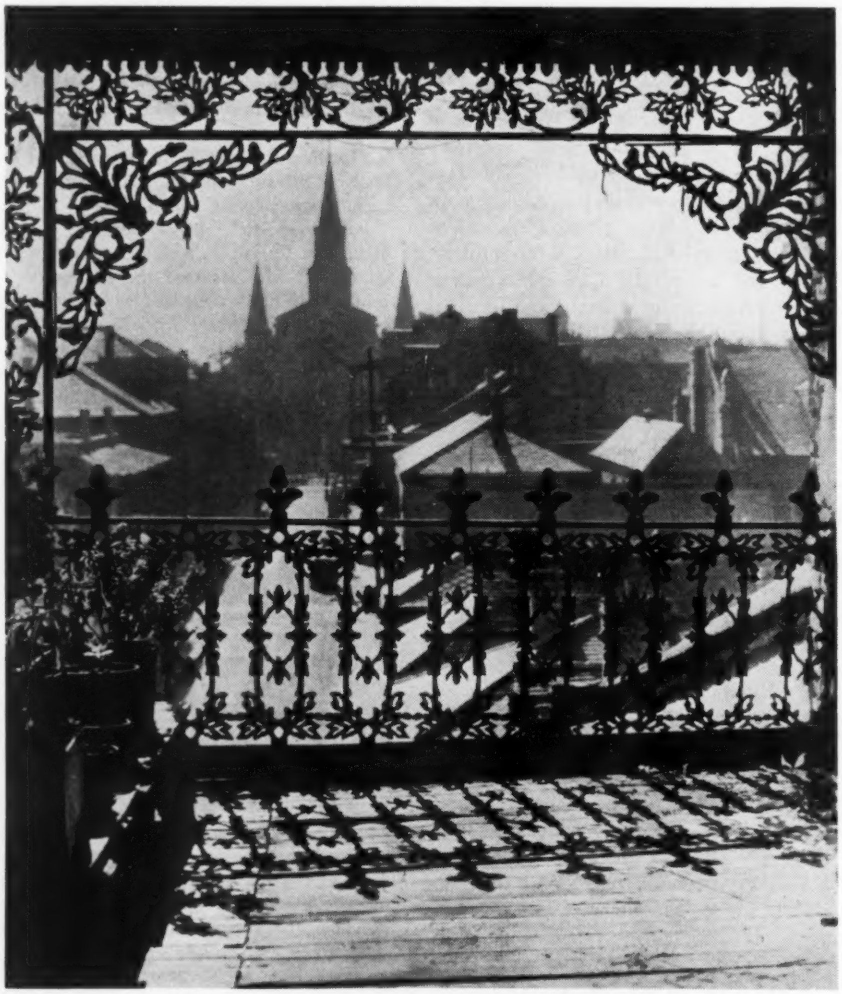
HONORS NIGHT: Charles E. Gus, chairman, Theodore Baumeister, A. C. Coonradt, C. Kenneth Holland, A. L. Kimball, and David B. Porter.

DINNER: Francis Hodgkinson, chairman, Mrs. G. W. Farny, V. M. Frost, C. A. Hescheles, C. F. Kayan, W. W. Lawrence, S. H. Libby, H. G. Oliver, Jr., and J. I. Yellott.

PHOTOGRAPHIC EXHIBIT: C. G. Humphreys, chairman, W. L. Betts, J. F. Guinan, L. J. Levert, J. A. Lucas, H. B. Stoddard (A.I.E.E.), F. L. Tyler (A.I.Ch.E.), C. B. Le Page, L. F. Zsuffa, and W. C. Woodman.

PLANT VISITS: H. A. Cox, chairman, D. C. Luce, H. A. Johnson, and H. E. Stoeltzing.

WOMEN'S COMMITTEE: Mrs. J. A. Brooks, general chairman; Mr. R. B. Purdy, vice-chairman; Mrs. C. H. Young, registration; Mrs. A. M. Feldman, excursions; Mrs. F. M. Gibson, Monday evening; Mrs. A. D. Blake, annual luncheon; Mrs. G. L. Knight, Tuesday evening; and Mrs. R. V. Wright, annual tea.



ST. LOUIS CATHEDRAL, AT NEW ORLEANS, LA., WHERE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS HOLDS ITS NATIONAL SPRING MEETING, FEBRUARY 23–25, 1938, SEEN THROUGH A SETTING OF IRON WORK IN THE FRENCH QUARTER

To A.S.M.E. Members:

THE COUNCIL REPORTS FOR 1938

THE WORK of the Society is being carried on by over 2000 different members who are devoting their time and effort to standing, special, and technical committees, Professional Divisions, Local Sections, and Student Branches. At the end of the year, the Council has the responsibility to summarize, evaluate, and record the principal activities concisely so that the members may have a clear view and future Councils a basis for planning their work. In addition to activities under its sole control the Society participates in the work of joint agencies in fields where united action is desirable and it is proper to include comment on them in this report.

The general economic background against which the Society's activities must be viewed showed a substantial recession in industrial and engineering activity which started during the early fall of 1937, was maintained throughout the fiscal year but at the end gave promise of upturn. Decreased engineering employment prevailed during this period but not to as great an extent as in 1933.

In general, the work of the Society progressed during the year at a steady pace along well-established lines. The principal accomplishments, innovations initiated, and situations met are summarized below. Many of them will be discussed later in the report.

YEAR'S HIGH LIGHTS SHOW WIDE MEMBER PARTICIPATION

1 Four national meetings of the Society were held, at Erie, Pa., New York, N. Y., Los Angeles, Calif., and St. Louis, Mo.

2 At the four National Meetings and at seven meetings of Professional Divisions 253 papers and addresses were presented by 304 authors in 102 sessions before 5356 individuals.

3 Local Sections reported 680 meetings and Student Branches reported 655 meetings.

4 During the year 224 papers were published, 100 in Transactions and 124 in MECHANICAL ENGINEERING. Special distribution was made of 52 papers by the Textile, Wood Industries, Fuels, Petroleum, and Oil and Gas Power divisions.

5 Procedures were adopted to provide limited preprints of papers, to print discussions with the papers in Transactions, and to improve quality of papers accepted and of meeting program content.

6 The American Engineering Council initiated a new function, discussion of public problems related to engineering at forums to be held in various metropolitan centers.

7 The curricula accredited by the Engineers' Council for Professional Development were accepted by the Society as a basis for determining "schools of engineering of accepted standing," in the requirements for establishing Student Branches and determining membership qualifications.

8 The Model Law for Registration as revised December, 1937, was approved.

9 The Council, the President, and the staff spent a large amount of time on matters relating to the "Parker Case."

10 More than 5200 student members enrolled in 117 Student Branches.

11 The pages in MECHANICAL ENGINEERING devoted to Society news were doubled as compared to 1936–1937, increasing reader interest and giving increased support to Society activities, particularly those of Local Sections, Junior Groups, and Student Branches.

12 Membership increased from 14,282 to 14,374.

13 Expenditures were kept well within income.

14 The Mechanical Catalog, now styled "A.S.M.E. Mechanical Catalog and Directory," was issued with a classified directory of mechanical equipment, compiled on a free-listing basis, the same as was done prior to 1932.

BETTER PAPERS, MEETINGS, AND PUBLICATIONS

During the last few years, papers which have been accepted for publication have, in so far as practicable, appeared in Transactions or MECHANICAL ENGINEERING prior to the meeting at which they were presented. Discussion was printed subsequent to the meeting. This procedure was subject to criticism by members because: (1) The rigorous printing schedule of the regular publications made it difficult to handle all papers in advance of the meeting; (2) preprints in convenient pamphlet form were not available; and (3) printing the discussion separately from the paper itself was confusing and frequently misleading. All of the committees concerned with program making have for several years recommended that pamphlet preprints be provided as soon as finances permitted and that publication with discussion be postponed until after the meeting.

When the budget was adopted in June, the Council was not able to provide the necessary additional funds for preprints. During the summer, the Advisory Board on Technology and the committees on Professional Divisions, Meetings and Program, and Publications developed procedures which released some funds from regular publication procedures and made limited preprints possible. These procedures have been accepted by the program-making agencies and adopted by the Council, and were in partial effect as the 1938–1939 fiscal year opened on October 1, 1938. They may be briefly summarized as follows:

1 Papers are to be limited to 4000 words, in so far as it is practical to do so.

2 Greater care is to be exercised in reviewing and recommending papers for publication.

3 Greater efforts are to be expended in securing manuscripts in advance of meetings.

4 Meeting programs to be based on papers in hand rather than on papers to be solicited.

5 Number of sessions at National Meetings to be limited and papers at each session limited to two.

6 Preprints of papers selected for Transactions to be available on request previous to the meetings.

7 Papers to be printed in Transactions after presentation and to appear complete with discussion and author's closure to the discussion.

These procedures and plans[1] have been adopted in the hope that the publications and meetings will be improved. A reduction of the number of sessions at National Meetings with a consequent reduction of conflicting interest between sessions

[1] A more complete presentation of these new procedures appeared on page 787 of the October, 1938, issue of MECHANICAL ENGINEERING.

will undoubtedly be welcomed, as will the improvement in quality of papers and the availability of preprints.

During the year, increased attention has been given by the Committee on Local Sections and the officers of the individual Local Sections to the importance of improving the quality of Local Sections programs. A "program-makers bulletin" issued monthly, contains helpful suggestions for programs and records experiences to be followed and avoided in planning and conducting programs for Local Sections.

AMERICAN ENGINEERING COUNCIL ADDS A DISCUSSION FUNCTION

The American Engineering Council is the joint organization of the engineering profession "to further the public welfare wherever technical and engineering knowledge and experience are involved and to consider and act upon matters of concern to the engineering and allied technical professions." The American Engineering Council is supported by 52 member bodies, 30 local, 15 state, and 7 national, of which The American Society of Mechanical Engineers is one.

The opportunity for the American Engineering Council is broad, perhaps broader than its financial resources. In an effort to focus its work more clearly, the American Engineering Council stated its program for 1938 under five major headings:

First, the Public Affairs Function to provide considered opinion of the engineering profession for the aid of the legislative and administrative branches of the Federal Government.

Second, the Public Discussion Function in which public problems related to engineering could be discussed for the purpose of clarifying engineers' opinions.

Third, Engineers' Embassy Functions rendering service to member Societies and their individual members on engineering matters in the several branches of the Federal Government.

Fourth, Publicity Function reporting regularly to member organizations.

Fifth, Fact-Finding Function as finances permit, making studies of basic economic relationships of engineering to employment, technologic advance, and public questions involving capital goods, construction, extractive, and process industries.

The new and significant element in this program is the public-discussion function which was initiated by a successful forum conducted in Philadelphia in May, with the cooperation of the Philadelphia Engineers' Club. The general relationship of technology to employment was discussed by leading economists and engineers. A second forum to discuss "Invention and the Engineer's Relation to It" was held in Detroit in November, 1938, under the sponsorship of the Michigan Engineering Society.

In September, the Seventh International Management Congress was held in Washington and the officers and staff of the American Engineering Council aided wholeheartedly in its planning and conduct. The first Congress held in Prague in 1924 resulted from the report on "Waste in Industry" published by the American Engineering Council in 1920–1921 and the desire of the newly formed Czechoslovak government to take advantage of the report. The series of conferences that followed was therefore the result of the work of the American Engineering Council and it was fitting that the Council should aid actively in the recent successful Congress in which 1500 leaders of management and industry from 20 countries participated.

THE ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT[2] COMPLETES SIX YEARS

The work of the Engineers' Council for Professional Development relates closely to the purpose and policies of this Society. The program of E.C.P.D., designed to establish a clear line of development for the young engineer from the time he decides to enter engineering until he is recognized as a member of the profession, has four principal parts: The first of these has to do with the decision by the student in the secondary school as to whether he will or will not enter engineering. The second is related to the period of formal engineering education and during the last five years has been devoted entirely to the accrediting of engineering schools. The third is concerned with the engineering graduate during the period from graduation to his entry into the profession. The fourth deals with the correlation of methods for recognition of attainment in the profession, the registration laws, the degrees given to engineers, and the grades of membership in the national engineering societies.

Accrediting Engineering Schools. The program of accrediting engineering schools started by E.C.P.D. in 1933, has reached the close of its first stage. On September 30, 1938, of the 679 curricula submitted to E.C.P.D., 445 had been accredited and 172 had not. Sixty-two curricula were to be taken up by E.C.P.D. in October, 1938. Of the 123 curricula in mechanical engineering submitted to E.C.P.D., 92 had been accredited, 20 had not been accredited, and 11 were to be considered in October.

The accrediting of engineering schools touches the work of the Society at two points: First, our By-Laws provide that Student Branches shall be established only at an approved institution; second, candidates for membership may present evidence of graduation from "a school of engineering of accepted standing" in place of a certain amount of otherwise required experience. The Society, therefore, is immediately concerned with the accrediting program, and the Council, at its meeting in St. Louis in June adopted the following policy:

1 A "school of engineering of accepted standing" as used in Constitution and By-Laws of the Society is to be a school with one or more engineering curricula approved by the E.C.P.D.

2 Graduates from institutions not on the E.C.P.D. accredited list may be admitted to membership on the basis of experience. (See Constitution.)

3 Additional student branches of the A.S.M.E. may be approved only in institutions on the E.C.P.D. accredited list in mechanical engineering. Exceptions to this rule may be made in the case of institutions offering curricula in general engineering, which have been approved by E.C.P.D.

4 Institutions not on the E.C.P.D. accredited list in mechanical or general engineering, but having A.S.M.E. student branches, are to be given a provisional status, the duration of such a status to be determined by the Committee on Relations With Colleges, but not to exceed four years.

5 The A.S.M.E. Committee on Relations With Colleges should appraise the status of mechanical-engineering students enrolled in curricula not on the E.C.P.D. accredited list and also those enrolled in institutions which do not have A.S.M.E. student branches. Such students may be permitted to affiliate with branches in near-by approved institutions under conditions laid down by the A.S.M.E. Committee on Relations With Colleges.

6 A.S.M.E. student branches should be approved only for institutions in the United States of America. Exceptions to this rule may be made by the Committee on Relations With Colleges if the institution outside of the U. S. A. applying for a student branch has superior facilities for instruction in mechanical engineering and a curriculum which compares favorably with the best approved programs of study in this country.

Other Phases of E.C.P.D. Program. The procedure of advising and guiding young men before they enter an engineering career is best carried out under the leadership of local committees of

[2] For a report of the sixth annual meeting of E.C.P.D. see MECHANICAL ENGINEERING for December, 1938, p. 957.

engineers acting with high schools, preparatory schools, and junior colleges. Splendid progress has been made by several local engineering groups with the cooperation of A.S.M.E. Sections. It is hoped that as time goes on this program will be intensified and developed.

The program of training for the young engineering graduates is in all respects parallel with the Junior program of the Society. Close cooperation is expected between E.C.P.D. and the agencies within the Society that are concerned with the Junior program. It was the Juniors of our Society a decade ago who called for aid in securing professional status; the Society investigated, found the problem one for the whole profession, and took the measures which culminated in E.C.P.D. It is our privilege, through our Student Branches, our Local Sections, and our publications, to do a continuously better job for our young men, aided by the counsel and cooperation of the profession at large as represented by E.C.P.D., with pride that we are reaping the fruits of our own early plans.

THE MODEL REGISTRATION LAW REVISED

At the present time forty states require that the engineers who practice in the states be licensed by the states. Greater uniformity among the states in educational and experience requirements and in provision for reciprocal practice is an increasingly important problem. To aid in its solution the Council approved the Model Law for Registration as revised in December, 1937.

This revision, which resulted from conferences and correspondence between representatives of many bodies, and which continued over nine months, brings the Law more fully abreast of the times.

COOPERATION IN THE PROFESSION IS INTERNATIONAL

In addition to the bodies whose work has been mentioned at length, the Society cooperates with other similar societies in: The United Engineering Trustees, Inc., Engineering Societies Employment Service, American Standards Association, International Electrotechnical Commission, National Research Council, National Management Council, National Bureau of Registration, American Association for the Advancement of Science. It also participates in the administration of several joint awards: John Fritz Medal, Herbert Hoover Medal, Washington Award, Daniel Guggenheim Medal, Gantt Medal, and Alfred Noble Prize.

The Society participated in several important international engineering events: The International Engineering Congress in Glasgow, June, 1938; the Fifth International Congress for Applied Mechanics, Cambridge, Mass., September, 1938, and the Seventh International Management Congress, Washington, September, 1938.

Representatives of the Society and its Power Test Codes Committee participated in the meetings of the International Electrotechnical Commission in England in the summer of 1938.

The Society notes with regret the retirement of two leaders of the engineering profession who have long been associated with better understanding between the engineers of various countries: Dr. Conrad Matschoss, Mem. A.S.M.E., retired December, 1937, as Director of the Verein deutscher Ingenieure; Richard J. Durley, Mem. A.S.M.E., retired in January, 1938, as secretary of the Engineering Institute of Canada.

MEMBERSHIP AFFECTED BY POLICY CHANGES

The tabulation on this page shows the status of the membership on September 30, 1938, the changes during the year, and the results of policies recently adopted.

In accord with the 1935 change in the Constitution, 15 associate members were automatically transferred to the grade of member as they reached the age of 30. The associate member thus disappears as a classification of Society membership.

In 1937, by a change in the Constitution, the basis for Junior dues was changed from "duration of membership" to "age." A year ago Juniors paid $10 a year during the first six years after entering the Society and thereafter paid $20. Now Juniors pay $10 until the age of 30, $15 between the ages of 30 and 33, and $20 after 33. The total number of Juniors at the end of the year is 5497 compared with 5424 at the beginning.

Last year, the Fellow grade was established by the promotion of qualified members and former members of the Council. During the year 26 new Fellows were elected by the Council, the first thus chosen under the new provision for this grade.

On September 30, 1938, the percentage of fully paid members was 89.62. The corresponding figure a year ago was 89.36.

The Committee on Admissions considered 2705 applications during the year, 2054 being transfers of Student members.

PARKER CASE[3] STILL IN THE COURTS

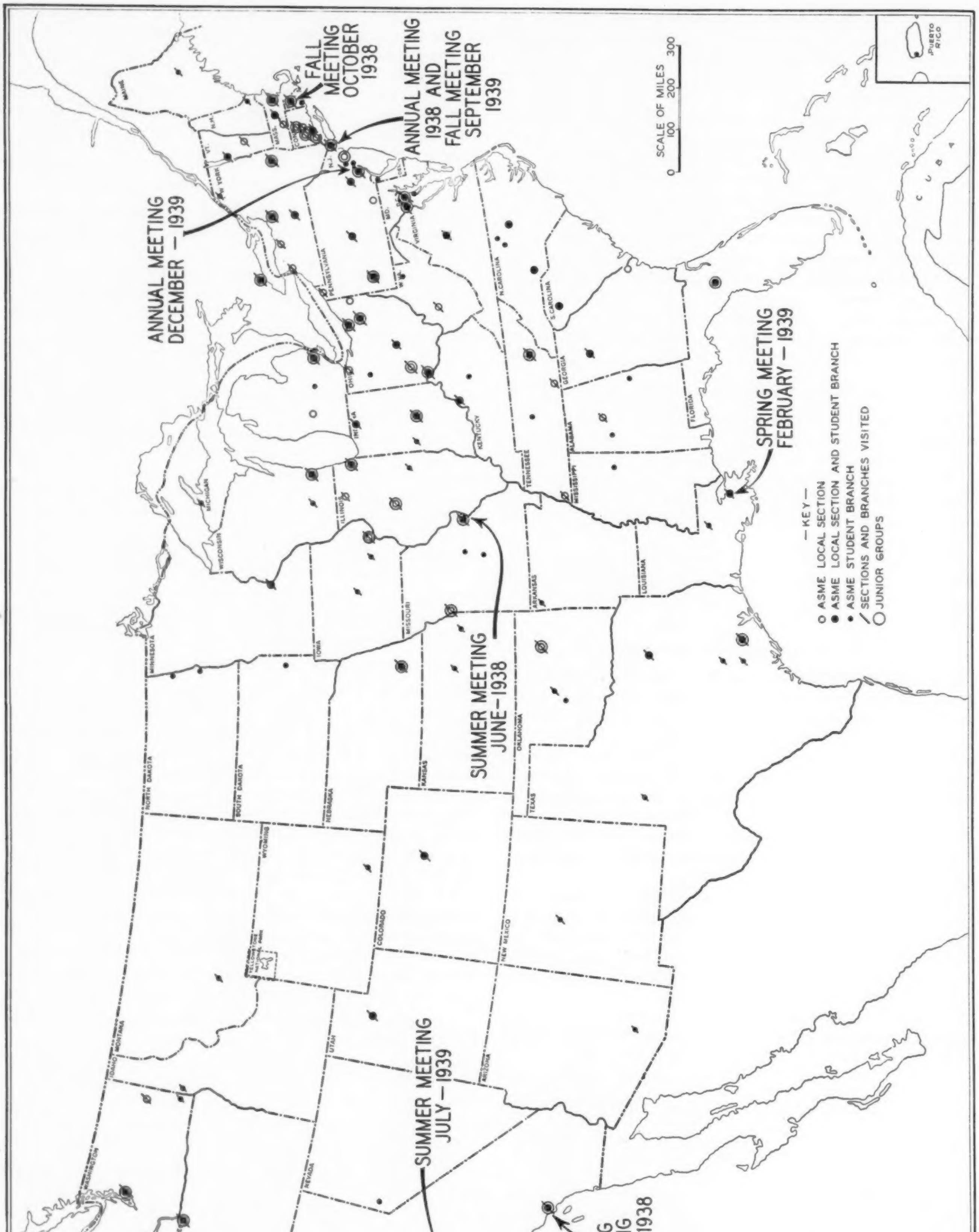
In 1935, the New York Supreme Court decided in the visitation proceeding brought by Mr. John Clinton Parker, "that none of the property or funds of the corporation have been misappropriated or diverted to any other purpose than that for which such corporation was incorporated." Notwithstanding this decision, Mr. Parker brought legal action against the Society and its Council in December, 1936, seeking the restitution to the Society treasury of funds spent on the Engineering Index as an activity outside the scope of the Society's charter and asking that the arrangement between the Society and Engineering Index, Inc., by which the Index is carried on by a nonprofit, membership corporation, be set aside. The Society through its counsel attempted to have this second action dismissed on the ground that the previous decision in the visitation proceeding covered the case. It was not possible to have this done because a decision in a visitation proceeding was held not to be con-

[3] A memorandum on the "Parker Case," prepared by President Harvey N. Davis is available on request.

CHANGES IN MEMBERSHIP

(September 30, 1937, to September 30, 1938)

	Membership		Increases			Decreases				Changes		
	Sept. 30, 1938	Sept. 30, 1937	Transferred to	Elected	Reinstated	Transferred from	Resigned	Dropped	Died	Increases	Decreases	Net changes
Honorary Members	14	14	...	1	...	...	...	...	1	1	1	...
Fellows	96	73	25	1	...	...	...	...	3	26	3	+23
Members	8337	8510	112	201	112	25	168	305	100	425	598	−173
Associate Members	....	15	...	...	...	15	...	...	...	....	15	−15
Associates	230	246	...	6	3	4	13	5	3	9	25	−16
Junior (20)	894	1078	4	35	34	87	59	111	...	73	257	−184
Junior (15)	604	....	698	43	17	29	35	90	...	758	154	+604
Junior (10)	4199	4346	11	963	26	690	98	358	1	1000	1147	−147
Total Membership	14,374	14,282	850	1250	192	850	373	869	108	2292	2200	+92



THE GEOGRAPHICAL SCOPE OF THE SOCIETY'S PROBLEM. NOTE THE JUNIOR GROUPS

clusive in a subsequent action brought against the directors.

The new case was tried in May, 1938, and June 11, 1938, the decision of Mr. Justice William Harman Black was handed down. In it, Mr. Justice Black reached the following principal conclusions:

> The publication of the Index Services by the Society was not *ultra vires*.
>
> Nevertheless, the inauguration of these Services and their continuation thereafter, constituted negligence on the part of the Council members and officers of the Society.
>
> The Society was damaged to the extent of about $215,000, being approximately the amount expended by it on the Index Services during the period in question.
>
> It was *ultra vires* for the Council to endorse the organization of Engineering Index, Inc., and to make the contract of September 28, 1934, under which Engineering Index, Inc., took over from the Society the publication of the Index Services. The contract should therefore be voided and the Index returned to the Society.
>
> The Society should conduct a letter ballot of its members to ascertain whether they wish the Index Services continued, and, if so, in what form.

At the Business Session of the Society[4] in St. Louis on June 20, 1938, it was unanimously voted to take an appeal from the judgment to be entered. The members of the Society present at the meeting apparently objected to both the assignment of undeserved responsibility to past officers and the Court's intention to upset what is regarded as a highly satisfactory solution of the Index problem. On June 22, 1938, Mr. Justice Black granted a stay of judgment pending an appeal. The appeal will be argued in November.

THE COUNCIL GIVES MUCH TIME TO SOCIETY MATTERS

The Council met on three days at the 1937 Annual Meeting and on two days at the Semi-Annual Meeting in St. Louis in June, 1938. An informal meeting of Council members was held in Los Angeles in March, 1938. In addition to its meetings just prior to the two Council meetings, the Executive Committee of Council met eight times during the fiscal year.

President Davis traveled extensively during the year, visiting 32 Sections and 42 Student Branches. On one trip of two months, he visited the Pacific Coast. Members of the Council attended the ten Student Branch Conferences and the seven Group Conferences of Delegates of Local Sections. In addition they visited 20 Sections and 28 Student Branches.

Among matters taken up by the Council and the Executive Committee during the year and not elsewhere noted in this report were:

1 Extended consideration of recommendations of Sections Delegates.

2 Establishment of Committee on Education.

3 Approval of schedule of fees for consulting services on Housing.

4 Review of ten years' successful operation of the Woman's Auxiliary which conducts the women's events at the Annual Meeting and operates a loan fund from which $8900 has been loaned to 39 students in the last ten years. The Auxiliary is now organizing Local Sections.

5 Selection of new pin and new certificate for the Fellow grade of membership.

[4] MECHANICAL ENGINEERING, August, 1938, page 647, contains complete resolution adopted by the Business Session, June 20, 1938.

COMMITTEE REPORTS REVEAL MANY ACTIVITIES

The 16 standing and 20 special committees submit annual reports to the Council. These have been drawn on fully in the preceding paragraphs. The report of the Finance Committee in full follows this report of the Council. Reports of the other committees and of the joint bodies in which A.S.M.E. participates are available to each member on request. The abstracts which follow give a concise view of the year's work.

Publications

The Committee on Publications reports with satisfaction the adoption of the policy for providing preprints of Society meeting papers (discussed at length in the preceding paragraphs) and a decided enlargement of the directory section of the Mechanical Catalog now known as "The A.S.M.E. Mechanical Catalog and Directory." The Committee regrets the fact that funds were not available to publish a 1938 Membership List.

Meetings and Program

Last year the Committee hailed as an outstanding development the adoption of the policy by the Council whereby the Society may hold four national meetings annually. Four such meetings were held during the year: Fall, at Erie, Pa.; Annual, at New York; Spring, at Los Angeles; and Semi-Annual at St. Louis, Mo. The total registered attendance of members and guests at these meetings was over four thousand. In addition to the programs of good papers, the following noteworthy addresses were presented:

Fall Meeting at Erie:
- "Wealth and Engineering," by A. R. Smith
- "Present Status of the Emmet Mercury-Vapor Process," by W. LeR. Emmet

Annual Meeting at New York:
- Thurston Lecture, "Seeing the Unseen," by R. Merwin Horn
- Presidential Address, by James H. Herron
- Towne Lecture, "The Simian Basis of Human Mechanics," by Ernest A. Hooton

Spring Meeting at Los Angeles:
- "The Engineer in Public Life," by Earl R. Hedrick
- "The Engineer of the Future," by President Harvey N. Davis

Semi-Annual Meeting at St. Louis:
- Calvin W. Rice Lecture, "Some Contributions of Metallurgy to Engineering Progress," by William R. Barclay
- "The Manufacture of High-Speed Tanks," by J. K. Christmas
- "Engineering and Health," by President Harvey N. Davis

In cooperation with the Committee on Professional Divisions a policy has been formulated requiring that papers must be received 90 days in advance of a meeting. It is hoped that this will give the program-making agencies an opportunity to make better selections of program material and utilize the program time to greater advantage. In order to secure a balance on the strength of the four national meetings the Committee has adopted a general pattern for the meetings, providing 12 sessions at the Spring and Fall Meetings, 15 sessions at the Semi-Annual Meeting, and 24 sessions at the Annual Meeting.

Professional Divisions

The Society year 1937–1938 witnessed operation of the Society's program under the fully organized departmental system, and experiences to date bear evidence of the advantages offered by the five departmental groupings. Important among the decisions reached by the Committee has been the fixing of a 90-day period which will be enforced between the submission of a paper and the regularly scheduled meeting at which it is to be read. This, together with a reduction in the number of

simultaneous sessions, which will be enforced at the suggestion of the Committee on Meetings and Program should greatly improve the interest, value, and quality of technical sessions.

During the year, in addition to aiding in the preparation of the national meeting programs of the Society, individual divisions held seven meetings separately from the national meetings of the Society as follows:

Textile, Boston, Mass., October, 1937
Fuels, Jointly With Coal Division of A.I.M.E., Pittsburgh, Pa., October, 1937
Wood Industries, Grand Rapids, Mich., October, 1937, and High Point, N. C., September, 1938
Petroleum, Fluid Metering Conference, Norman, Okla., April, 1938
Machine Shop Practice, Rochester, N. Y., May, 1938
Oil and Gas Power, Dallas, Tex., June, 1938

In addition, the Applied Mechanics Division cooperated with the International Congress for Applied Mechanics, Cambridge, Mass., in September, 1938.

During the year the Heat Transfer Committee of the Process Industries Division was reconstituted as a Heat Transfer Group.

Local Sections

On September 30, 1938, 13,170 members of the Society were located in areas which may be served by the 71 Local Sections. These Sections held 680 meetings. During the year the Committee on Local Sections and the individual Conference of Local Section Delegates placed a great deal of emphasis upon the need for improving the quality of programs for the various Section meetings. A subcommittee issues a monthly bulletin to program chairmen which contains useful suggestions and assistance for those charged with the responsibility of preparing programs. Juniors have shown an increasing amount of interest in the work of the Society as evidenced by special Junior Group meetings in the various Sections.

Conference of Local Sections Delegates

The Conference of Local Sections Delegates again proved its usefulness. For the last three years delegates of the Sections in each area have met in the fall and have given time to thoughtful consideration of Society problems. The representatives of these Group Conferences have met in New York during the time of the Annual Meeting, where the views brought out in Group Conferences have been given further consideration on a national basis and the resulting suggestions have been brought to the Council and the membership at large. This has resulted in writing many progressive ideas into Society procedure.

Student Branches

The A.S.M.E. Student Membership plan continues to make new records. More than 5200 student members enrolled in the college year 1937–1938 in 117 Student Branches. Of the 1937 class, 937 have transferred to junior membership. Of the 1938 class, 521 thus far have transferred. The 117 Branches reported a total of 655 meetings. Three new Student Branches were established at the universities of Arizona, British Columbia, and Maryland. Because the engineering department at the University of North Carolina was transferred to the North Carolina State College, our Student Branch at the university was disbanded. Ten Student Group meetings were held in various geographical districts, with a total attendance of 1700 students and faculty members.

Library

An interesting group of letters has been received commenting on the report of the Library Board which was sent out for suggestions. In general, these letters recognized the difficulties under which the Library Board is operating with respect to funds and complimented it on the amount of work it was able to do with available funds.

All letters expressed a hope that arrangements could be made to increase the availability of library material to those outside of the immediate territory of the library. This problem has been before the Board for years and some steps have been taken to increase this service. However, until ways and means can be developed to increase this service without material increase in available funds, the prospects are not encouraging.

Honors and Awards

Upon the Society's nomination, Henry Ford has been awarded the James Watt International Medal by The Institution of Mechanical Engineers.

During the year, the following honors and awards were bestowed by the Society:

Honorary Membership to Lorenzo Allievi
A.S.M.E. Medal to Edward P. Bullard
Holley Medal to Frederick G. Cottrell
Worcester Reed Warner Medal to Clarence F. Hirshfeld
Spirit of St. Louis Medal to James H. Doolittle
Melville Medal to Alfred J. Büchi
Junior Award to Leslie J. Hooper
Charles T. Main Award to Allan P. Stern
Student Award (Undergraduate) to Gino J. Marinelli

The triennial award of the Spirit of St. Louis Medal was made at the Semi-Annual Meeting in St. Louis. The Melville Medal was presented at a special meeting of the Metropolitan Section on September 26, 1938. All the other medals and awards were bestowed at the Annual Meeting.

The Society has accepted the responsibility of administering the Pi Tau Sigma Award for "recognition of outstanding young mechanical engineers.

The Society has accepted custody of the Spirit of St. Louis Junior Award donated by the St. Louis Section for the best aeronautic paper given by a Junior member before a Junior group.

Research

The large majority of the 22 research committees have made good progress toward the completion of the projects assigned to them. Six of the committees sponsored technical sessions at the general meetings of the Society for the purposes: (*a*) of acquainting the membership with their plans for research, (*b*) of presenting problems which have arisen during a study, or (*c*) of reporting data and information resulting from their investigations.

The two outstanding accomplishments of the year resulting from the work of the Society's research committees are (1) the completion of the voluminous report called "Assembly and Interpretation of Available Creep-Test Data." This volume of 270 charts, 73 tables, and 430 sheets of primary data, published jointly by the A.S.T.M. and the A.S.M.E., was available early in the fall. (2) The completion of the editing of the manuscript of the report on metal cutting data which when published is to be called a "Manual on the Cutting of Metals."

Standardization

Satisfactory progress was made by the 321 sectional committees, subcommittees, and subgroups at work during the year on standards projects. Six completed standards were presented to the American Standards Association for approval and designation as American Standard within that period and many of the proposals were advanced one, two, or three steps toward such submission.

The six completed proposals are: Face-to-Face Dimensions of Ferrous Flanged and Welding End Valves, Terminology and Definitions for Single-Point Cutting Tools, Time Series Charts, Twist Drills, Steel Pipe Flanges and Flanged Fittings, Revision, and Cast-Iron Pipe Flanges and Flanged Fittings, Revision.

Power Test Codes

The Power Test Codes Committee announces the election of Francis Hodgkinson to the chairmanship. In accepting this position he has assumed the leadership so ably exercised by Dr. Fred R. Low and Dr. Robert H. Fernald.

A second important announcement is the approval and publication of revisions both of the Test Code for Hydraulic Prime Movers and the Test Code for Steam-Condensing Apparatus.

Progress made during the year in the revision of certain of the other test codes has been considerable. We are promised in the near future revised editions of the section on Definitions and Values, and the codes for Steam Turbines and Displacement Compressors and Blowers. In addition, there will be new codes on Gaseous Fuels and on Fans together with the report on Flow Measurement by means of the Standardized Nozzles and Orifice Plates.

Safety

There are three items of special interest in the annual report of the Safety Committee. The first is the completion of the Safety Code for Compressed-Air Machinery and Equipment, the second, a long step toward completion of the Safety Code for Cranes, Derricks, and Hoists, and, the third, the distribution by sale of the entire editions of the Safety Code for Elevators (3100 copies) and the Elevator-Inspectors' Manual (3500 copies) within the seven months following publication.

The subcommittees of the new Sectional Committee on a Safety Code for Conveyors and Conveying Machinery have been active during the year and have held a number of meetings.

Boiler Code Committee

The regular interpretation work of the committee was maintained. The outstanding accomplishment during the last fiscal year is the adoption of allowable working stresses for ferrous and nonferrous materials. In addition, the rules for fusion welding have been extended to apply to tube and pipe connections which are not in contact with furnace gases. A study is being made to provide rules for the use of stainless steel and clad materials. A form for data to be supplied to the committee was prepared for use by interested parties who wish to obtain authorization to employ materials not approved by the present rules for code vessels.

Board of Review

This Board makes recommendations to the Council regarding reinstatement of dropped members, resignations, and other related matters. During the year 546 cases were considered, compared to 963 the previous year.

The policy for handling dropped and resigned members adopted last year has proved satisfactory.

Economic Status of the Engineer

Status of the Committee. Disturbances and confusion which have arisen in industry and in the community in recent years have forced engineers to devote more thought and effort than formerly to their economic well being, as compared with strictly professional and technical matters.

At the beginning of the present year, therefore, it appeared that the Committee on the Economic Status of the Engineer might well revise its aims and program and adapt them more closely to existing movements and trends. The committee has been at pains to understand fully its position, and to determine what work had best be done.

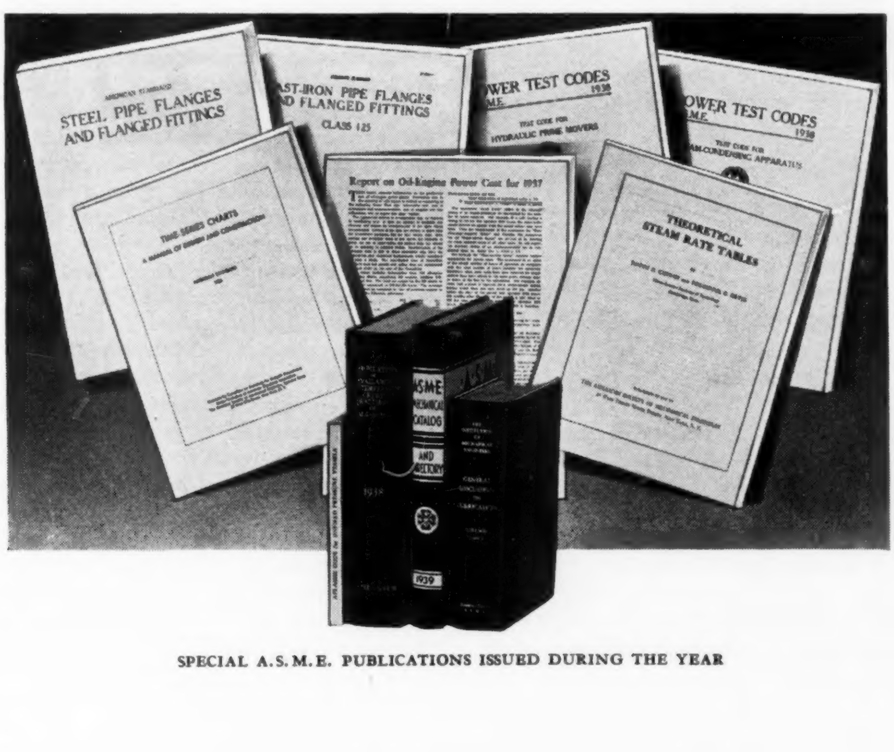
The first step agreed upon is a discussion of the problem of unionization in the mechanical-engineering field. The Committee has been negotiating during the last months to obtain a paper as a basis for discussion of this interesting and controversial subject.

DEATHS

Among the members who died this year were Nathanael Greene Herreshoff, an Honorary Member and Bennett M. Brigman, a Vice-President.

CONCLUSION

In submitting this report, the Council asks for the comment and criticism of policies and activities reported to the end that the purposes of the Society in the aid of the individual member may be more surely attained.



SPECIAL A.S.M.E. PUBLICATIONS ISSUED DURING THE YEAR

A.S.M.E. FINANCE COMMITTEE REPORT, 1937-1938

INCOME AND EXPENSE

THERE WAS a decrease in the total income received during the year 1937–1938, compared with the year 1936–1937, of $11,459.38. Membership dues received were slightly lower and revenues from MECHANICAL ENGINEERING advertising and Mechanical Catalog advertising were markedly lower. With the hope of increasing the usefulness and thereby the revenue in future years, the Mechanical Catalog again contains a free-listing Directory.

While the revenue from advertising was lower, there was a decided increase in the income from publication sales. This increase necessitated an increase in publication expense. The increase of $8412.63 in total expense over 1936–1937 was very largely made up of the previously mentioned increase in publication expense.

The net result of the year's operation was that $12,949.47 was added to surplus, which was $19,872.01 less than the previous year. There were various surplus adjustments. Chief among these was a write-down of securities (Society investments) in the amount of $15,933.03. The surplus now stands at $149,947.16 or $462.49 less than last year. (See Exhibit C of auditors' report.)

LIBRARY

Whereas the Society since 1926 has carried its substantial share in the Engineering Societies Library at the value of $1.00, the total value of the books in the Library on September 30, 1938, is $480,800, as reported by United Engineering Trustees, Inc.

CURRENT OPERATIONS

The Society operated during 1937–1938 without any borrowing. All Certificates of Indebtedness, with the exception of one in the amount of $500, not yet presented in response to call, were redeemed in 1936–1937. With the exception of this Certificate, of current accounts amounting to $499.80, and of obligations of $19,700.00 (for which invoices have not been received) incurred for the year's revenue-producing activities, the Society is without debt as of September 30, 1938.

TRUST FUNDS

The Finance Committee, with approval of Council, has adopted the policy of appropriating from surplus certain amounts of money to be used toward restoring trust funds to their original values. The effect of these and other operations are incorporated in the following statement covering the past year:

TRUST FUND ASSETS

	Original cost	Market or cost: whichever is lower
Balance at September 30, 1937	$134,974.24	$87,199.21
Net purchase of assets, 1937–1938	15,901.44	15,901.44
Reduction in uninvested cash, 1937–1938	13,145.01	13,145.01
Write down of securities to market, 9/30/38	....	2,913.75
Appropriations from Surplus 1937–1938	10,987.69	10,987.69
Balance at September 30, 1938	$148,718.36	$98,029.58

MORTGAGE CERTIFICATES

Mortgage certificates of Lawyers Mortgage Company remain the chief items of Society investment and trust-fund portfolios. The cost of these certificates as shown last year was $297,654.26 The then appraised value was $166,393.37. During the current year, $1653.45 has been redeemed leaving a cost value remaining of $296,000.81. As the present appraised market value is $147,934.89, a further write-down adjustment of $16,805.03 was made.

The cash income received during the year from these certificates was $13,947.43, including arrears. Nearly all of the mortgages underlying these certificates have been reorganized. Average percentage yields on real-estate mortgage bonds and certificates were:

	Trust-fund assets	Society investments	Aggregate
Based on cost	5.04	4.45	4.62
Based on market	10.33	8.98	9.37

K. M. IRWIN, *Chairman*
J. J. SWAN, *Vice-Chairman*
W. T. CONLON
J. L. KOPF
K. W. JAPPE
W. L. BATT
K. H. CONDIT
} *Council Representatives*
W. D. ENNIS, *Treasurer*

ACCOUNTANT'S CERTIFICATE

To THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

We have made an examination of the balance sheet of The American Society of Mechanical Engineers as at September 30, 1938, and of the summary of income and expenses and statement of surplus for the year ending that date. In connection therewith, we examined or tested accounting records of the Society and other supporting evidence and obtained information and explanations from an officer and employees of the Society; we also made a general review of the accounting methods and of the income and expense accounts for the year, but we did not make a detailed audit of the transactions.

In accordance with the practice followed by the Society in prior years, no effect has been given in the statements to accrued income on investments.

The membership dues are included in the income account of the current year on the basis of total cash received on account of that year and prior years, and provision has been made for all dues uncollected at September 30, 1938.

In our opinion, based on such examination and subject to the foregoing, the accompanying balance sheet and related summary of income and expenses and statement of surplus fairly present, in accordance with accepted principles of accounting consistently maintained by The American Society of Mechanical Engineers during the year under review, its position at September 30, 1938, and the result of its operations for the fiscal year ending that date.

New York, N. Y.
October 27, 1938

(Signed) PRICE, WATERHOUSE & Co.

EXHIBIT A—BALANCE SHEET, SEPTEMBER 30, 1938

ASSETS

General Fund:			
Cash in banks and on hand (including $510.00 reserved for retirement of certificate of indebtedness)			$ 84,437.00
Accounts receivable:			
Dues—current year	$19,747.28		
Dues—prior years	177.16		
	$19,924.44		
Less—Reserve	19,924.44	—	
Publications and advertising	$38,482.87		
Less—Reserve	3,715.52	$ 34,767.35	
Miscellaneous		1,655.74	36,423.09
Note receivable			159.49
Inventories:			
Publications completed		$ 14,784.96	
Publications in process		11,072.28	
		$ 25,857.24	
Less—Reserve		2,935.63	
		$ 22,921.61	
Supplies		2,311.01	25,232.62
Securities (at approximate quoted market values):			
Real-estate mortgage bonds and certificates		$ 96,202.76	
Railroad bonds		1,400.00	97,602.76
Deferred charges			296.13
			$244,151.09
Employees' Retirement Fund:			
Cash in banks		$ 2,427.03	
Real-estate mortgage certificate (at approximate quoted market value)		10,550.00	12,977.03
Trust Funds:			
Cash in banks		$ 20,940.00	
Notes receivable (Major Toltz Fund)		6,317.18	
Corporate stocks and bonds and real-estate mortgage certificates (at approximate quoted market values)		70,772.40	98,029.58
Property Fund:			
One-fourth interest in real estate and other assets of United Engineering Trustees, Inc., exclusive of Trust Funds		$498,448.48	
Office furniture and fixtures (depreciated value)		24,579.81	
Library books		1.00	
Engineering Index—Title and good will		1.00	523,030.29
			$878,187.99

LIABILITIES

General Fund:		
Certificate of indebtedness and accrued interest thereon		$ 510.00
Accounts payable		499.80
Accrued liabilities:		
Estimated liability relating to Mechanical Catalog for 1938–1939	$ 16,400.00	
Others (estimated)	3,300.00	19,700.00
Unexpended balances of Custodian Funds		22,878.30
Deferred credits:		
Dues and initiation fees paid in advance	$ 46,013.33	
Prepaid subscriptions	4,000.00	
Prepaid advertising	602.50	50,615.83
Surplus (Exhibit C)		149,947.16
		$244,151.09
Employees' Retirement Fund		12,977.03
Trust Funds:		
Principal	$78,249.43	
Income	19,780.15	
		98,029.58
Property Fund		523,030.29
		$878,187.99

NOTE: Initiation and promotion fees receivable are not included in the above statement as they are taken up by the Society only as and when collected.

EXHIBIT B

COMPARATIVE SUMMARY OF INCOME AND EXPENSES

For the Two Years Ending September 30, 1938

	Year 1937–1938	Year 1936–1937
INCOME:		
Initiation and promotion fees (to surplus)	$ 8,928.00	$ 8,726.90
Membership dues*	$210,656.80	$215,908.83
Student dues	15,693.50	13,560.50
Interest and discount	10,194.30	12,315.13
MECHANICAL ENGINEERING advertising	74,713.87	81,408.21
Mechanical Catalog advertising	40,996.39	48,865.63
Publications sales	61,786.38	54,359.45
Miscellaneous sales	1,727.61	1,966.75
Contributions—*Journal of Applied Mechanics*	1,775.00	875.00
Contributions—Unrestricted	516.52	554.37
Registration fees	409.00	261.00
Sale of equipment	262.50	233.50
Loss on sale of securities		—117.12
TOTAL INCOME	$418,731.87	$430,191.25
EXPENSES:		
Expenses under committee supervision	$ 79,585.57	$ 77,687.30
Publication expense (including provision for uncollectible accounts receivable other than dues; 1937–1938, $567.00; 1936–1937, $1,870.00)	135,234.70	128,469.68
Office expense	190,962.13	191,212.79
TOTAL EXPENSES	$405,782.40	$397,369.77
Net income for year	$ 12,949.47	$ 32,821.48

* Membership dues have been stated on the basis of total cash received during the year.

EXHIBIT C

STATEMENT OF SURPLUS

Year Ending September 30, 1938

BALANCE, SEPTEMBER 30, 1937		$150,409.65
ADD:		
Initiation and promotion fees collected		8,928.00*
Net income for year (Exhibit B)		12,949.47
Adjustment of reserve for life memberships		211.26
Proceeds from sale of bonds in excess of book value thereof		4,369.50
		$176,867.88
DEDUCT:		
Appropriations to Trust Funds:		
Net increase in surplus for the year ending September 30, 1937	$ 6,523.69	
One half of initiation and promotion fees collected in the year ending September 30, 1938	4,464.00	
Write down to approximate market value of securities owned at September 30, 1938 (exclusive of write down of $2,913.75 in respect of Trust Fund investments, charged against Trust Fund reserve)	15,933.03	26,920.72
BALANCE, SEPTEMBER 30, 1938		$149,947.16

* As it is the practice of the Society to take up initiation and promotion fees only as and when collected, the above statement does not include such fees receivable at September 30, 1938.

DETAILED COST OF A.S.M.E. ACTIVITIES, 1937–1938

	Expense under committee supervision	Printing and distribution expense	Office expense	Total cost 1937–1938	Total cost 1936–1937
Council	$ 4,922.64			$ 4,922.64	$ 4,384.53
Library	9,118.00			9,118.00	8,399.52
Library Stacks					1,500.00
American Engineering Council	11,200.00			11,200.00	9,750.00
Engineers' Council for Professional Development					850.00
Finance Committee Expense	115.14			115.14	110.39
Awards	474.86			474.86	439.30
Nominating Committee	434.18			434.18	480.81
Constitution and By-Laws					774.88
Local Sections	24,305.47		$ 7,053.99	31,359.46	28,374.87
Meetings and Program	6,906.53		3,647.51	10,554.04	10,121.87
Professional Divisions	2,981.45		3,647.51	6,628.96	6,179.07
Admissions			7,319.46	7,319.46	7,201.34
Employment Service	3,000.00			3,000.00	4,249.92
Student Branches	8,970.13	$ 4,446.93	7,190.75	20,607.81	17,620.04
Technical Committees	1,000.00		19,195.56	20,195.56	19,079.56
MECHANICAL ENGINEERING Text Pages		27,785.60	10,715.40	38,501.00	36,178.97
Transactions and *Journal of Applied Mechanics*	205.58	29,930.04	12,179.66	42,315.28	38,769.81
Membership List		6.54		6.54	8,650.61
MECHANICAL ENGINEERING Advertising Pages		17,224.28	21,180.90	38,405.18	41,762.19
Mechanical Catalog		20,727.93	16,725.56	37,453.49	36,494.58
Publications for Sale		35,113.38	7,853.84	42,967.22	35,153.65
Retirement Fund	4,080.00			4,080.00	4,080.00
Parker Case	573.09			573.09	888.88
Interest on Certificates of Indebtedness					918.50
Professional Services	1,298.50			1,298.50	1,511.56
Calvin Rice Memorial					250.00
International Management Congress					1,000.00
Secretary's Office			16,810.85	16,810.85	16,432.25
Accounting			12,741.53	12,741.53	13,109.44
General Service			26,544.80	26,544.80	25,307.22
General Office Expense			18,154.81	18,154.81	17,346.01
TOTALS	$79,585.57	$135,234.70	$190,962.13	$405,782.40	$397,369.77

Summary of A.S.M.E. Financial Statement for 1937–1938

DESPITE the fact that a portion of the fiscal year ending September 30, 1938, fell within the current recession, the results of the year have been gratifying from a financial point of view as will be revealed from the summarized statements that follow.

The Balance Sheet

From the balance sheet of September 30, 1938, we find that on that date:

The Society owed:

(1) One member who holds an unredeemed certificate of indebtedness with interest		$ 510.00
(2) Current bills		499.80
(3) Obligations for printing and distributing the 1939 Mechanical Catalog, bills for which have not been submitted		16,400.00
(4) Other obligations for which bills have not been submitted		3,300.00
(5) Special research and other committees which have collected funds for special purposes to be expended as needed		22,878.30
(6) For future services to Members who have prepaid their dues		46,013.33
(7) Advertisers and subscribers to publications who have prepaid		4,602.50
		$ 94,203.93
To meet these debts the Society had:		
(1) Cash in the bank		$ 84,437.00
(2) Accounts and notes receivable		36,582.58
(3) Inventories of publications and supplies conservatively valued at		25,232.62
(4) Securities at a quoted market value of		97,602.76
(5) Prepaid expenses of		296.13
		$244,151.09
The difference between the values held by the Society of $244,151.09 and debts of $94,203.93 is the net worth of the Society on September 30, 1938		$149,947.16
The Society had other liabilities:		
(1) Trust funds amounting to		$ 98,029.58
against which the Society had the following assets:		
(*a*) Cash	$ 20,940.00	
(*b*) Notes receivable	6,317.18	
(*c*) Securities of market value	70,772.40	
	$ 98,029.58	
(2) Property fund of		$523,030.29
with the following assets to support it:		
(*a*) Quarter interest in building	$498,448.48	
(*b*) Office furniture and fixtures (depreciated value)	24,579.81	
(*c*) Library books	1.00	
(*d*) Engineering Index—title and good will	1.00	
	$523,030.29	
(3) Employees' Retirement Fund of		$ 12,977.03
Covered by:		
Cash	$ 2,427.03	
Securities of market value	10,550.00	
	$ 12,977.03	

How the A.S.M.E. Spent Its Income in 1937–1938

Dues Income: $210,656.80—$14.66 per Member.

The principal item of income is the dues paid by the members. Juniors pay $10, $15, or $20 depending upon their age; Members pay $20, Fellows, $25, except that those who have been on the rolls of the Society for 35 years or who have reached 70 and have been members 30 years are carried without dues. On September 30 the Society had 14,374 members on its rolls and during the year $210,656.80 was collected in dues. The per-member dues income is therefore $14.66.

Publications: Net Expense $57,528.42—$4.00 per Member.

The publications of the Society are Mechanical Engineering, Transactions, including the *Journal of Applied Mechanics*, and the A.S.M.E. Catalog and Directory. Income is obtained from advertising in Mechanical Engineering and in the Catalog. Contributions have been received for the *Journal of Applied Mechanics*. An income and expense statement for the publications appears below:

Publications

	Direct expense	Income
Mechanical Engineering	$ 76,912.72	$ 74,713.87[a]
Transactions (Including *Journal of Applied Mechanics*)	42,315.28	1,775.00[a]
A.S.M.E. Mechanical Catalog	37,453.49	40,996.39
Publications sold	42,967.22	61,786.38
	$199,648.71	$179,271.64
Indirect Expense	$ 37,151.35	
	$236,800.06	
Less Income	179,271.64	
Net cost of publications	$ 57,528.42	
Total expense of publications per member	$ 16.47	
Publications Income per member	12.47	
Net expense per member	$ 4.00	

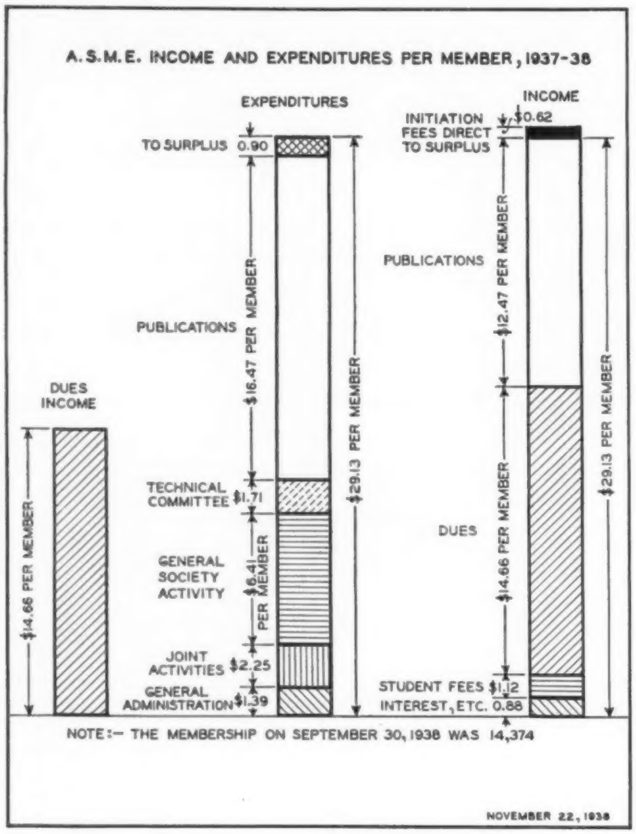
[a] No allowance is included for what might be considered as A.S.M.E. Member subscriptions to Mechanical Engineering or Transactions. The net expense of $4.00 may be regarded as the amount of these subscriptions.

Technical Committee Work: Net Expense $24,502.08—$1.71 per Member.

The Society has nearly 200 technical committees engaged in the work on research, establishing power test codes, preparing the boiler code, and in preparing standards and safety codes. The work of these committees is supported by direct staff expense which in 1937–1938 was $20,195.56. Adding to it indirect general expense of $4306.52 gives a total expense of $24,502.08, which on a per-member basis is $1.71. The principal output of the technical committees is publications which are sold to members and to others. This figure of expense should therefore be considered in relation to the publication expense of the Society.

General Society Activities: Net Expense $75,983.44—$5.29 per Member.

The general activities of the Society include the holding of meetings, the operation of Local Sections, Professional Divisions, Student Branches, the administration of the procedure for admitting members to the Society and the bestowal of awards. The Society receives income from Students for their membership



in the Society. The following tabulation shows the net expense for this activity.

General Society Activity Expenses

	Direct expense	Income
Society Meetings	$ 10,554.04	$ 409.00
Local Sections	31,359.46	
Professional Divisions	6,628.96	
Student Branches	20,607.81	15,693.50
Admissions	7,319.46	
Awards	474.86	
	$ 76,944.59	$ 16,102.50
Indirect Expense	$ 15,141.35	
	$ 92,085.94	
Less Income	16,102.50	
Net cost of general Society activities	$ 75,983.44	
Total Expense of general Society activities per member	$ 6.41	
Income per member	1.12	
Net Expense per member	$ 5.29	

Joint Activities: Net Expense $32,396.66—$2.25 per Member.

The Society also participates in a number of joint activities such as the Library, American Engineering Council, Engineers' Council for Professional Development, and the joint Employment Service. In addition to the payments to these joint bodies for these purposes a certain amount of general expense is allocated to these activities. The following tabulation gives the total of this expense:

Joint Activities

	Direct expense
Engineers' Council for Professional Development	.....
Engineering Societies Library	$ 9,118.00
American Engineering Council	11,200.00
Employment Service	3,000.00
	$ 23,318.00
Indirect Expense	9,078.66
Total cost of joint activities	$ 32,396.66
Expense per member	$ 2.25

Administrative: Net Expense $7296.73— $.51 per Member.

In carrying out the Society activities certain administrative services must be provided. These include the expense of the Council, the nominating committee and the provision for auditing, legal and other services. Certain general income is received. The following tabulation shows the amount of this expense and income.

General Society Administration

	Direct expense
Council	$ 4,922.64
Nominating Committee	434.18
Retirement Fund	4,080.00
Professional Services	1,298.50
Finance Committee	115.14
Parker Case	573.09
	$ 11,423.55
Indirect expense	8,574.11
	$ 19,997.66
Income from interest and miscellaneous	12,700.93
Net cost of general Society administration	$ 7,296.73
Expense per member	$ 1.39
Income per member	.88
Net expense per member	$ .51

Recapitulation

	Expense	Income
Dues	.....	$210,656.80
Publications	$236,800.06	179,271.64
General Society Activity	92,085.94	16,102.50
Technical Committee Work	24,502.08	.....
General Society Administration	19,997.66	12,700.93
Joint Activity	32,396.66	.....
	$405,782.40	$418,731.87
Addition to surplus from operating income	12,949.47	
	$418,731.87	

Income and Expense per Member

	Expense per member	Income per member	Net expense per member
Dues	....	$14.66	...
Publications	$16.47	12.47	$4.00
Technical Committee	1.71	....	1.71
General Society Activity	6.41	1.12	5.29
Joint Activities	2.25	....	2.25
General Society Administration	1.39	.88	.51
	$28.23	$29.13	
Addition to Surplus from operating income	.90		
	$29.13		

LETTERS AND COMMENT

Brief Articles of Current Interest, Discussion of Papers in Previous Issues

Smoke-Density Measurements

To the Editor:

Mr. Bumgardner's republication of his table[1] and chart is accompanied by one new suggestion, namely, that the smoke-indicating instrument be adjusted to give readings agreeing with the visual appearance of the gas stream emerging from the stack. The wisdom of this seems to me open to objection.

The object of smoke ordinances, and presumably of smoke observations, is to reduce atmospheric pollution. The quantity of polluting material issuing from a stack is presumably proportional to the product of the smoke density, the stack area, and the gas velocity. For smoke of a given density, issuing at a fixed velocity, the pollution varies as the square of the stack diameter. The visual density of the issuing stream varies as the logarithm of the stack diameter, as was shown by Mr. Bumgardner in 1933, when he published Fig. 1 of his present paper.[2] It may therefore be true that the visual appearance is a better quantitative index of pollution than is the absolute density of the smoke, but that visual appearance is an exact index cannot be seriously maintained, for it is subject to so many extraneous influences, as has been conclusively shown by Marks[3] in a paper in which he showed several convincing experimental demonstrations.

It would seem that a better attack on this problem would be to measure the absolute density of the smoke, and to make adjustments for stack size and gas velocity by subsequent computations. The quantity of gas discharged, which takes care of stack size and gas velocity, might well be taken as proportional to boiler load. The absolute density of the smoke is observed by an instrument which measures the light-absorbing power of a column of fixed thickness, as is done by several well-known instruments that have been on the market for some years.

In setting up his smoke-density scale in Fig. 1, the author seems to have taken 20 per cent absorption by a 5-ft column as the basis. He then computes the absorption of 10-, 15-, and 20-ft columns of this same smoke, and uses those values as the absorptions defining 5-ft columns of No. 2, No. 3, and No. 4 smoke. This is a distinct departure from previous practice, which has been to define the successive numbers in terms of equal increments of absorption (20, 40, 60, and 80 per cent) by a column of fixed thickness. It would seem to be more in accord with established practice to set up the smoke scale on this basis.

Thickness, ft	No. 1	No. 2	No. 3	No. 4
5	20	40	60	80
10	36	64	84	96
15	49	78	94	99
20	59	87	97	100

Thus it appears, essentially as in Mr. Bumgardner's table, that smoke which, from a 5-ft stack, would be rated as No. 1, when emerging from a 10-ft stack looks the same as No. 2 smoke from a 5-ft stack. The same smoke emerging from a 20-ft stack would be rated as No. 3. Doubling the stack diameter advances the apparent smoke rating by one grade.

Mr. Bumgardner tells us that "The proper distance between sleeves. . . .depends upon (1) the stack diameter and (2) the width of the breeching. . . ." It is not immediately evident how the width of the breeching has any influence on the observation. Presumably the density of the gas will be independent of the size of the passage through which it is flowing, and the velocity of gas flow should have no influence.

It is difficult to understand the statement that "The use of a definite smoke-stream thickness . . . was first suggested . . . in 1927," because at least one instrument on the market at that time operated on this principle.

The author argues from his Fig. 5 that the recording instrument is unsatisfactory. When he first published this chart[4] six years ago, it appears to have been used to support the contention that the instrument was on the whole satisfactory. At that time it was remarked that ". . . the automatic recorder . . . differs somewhat, with a slight evidence of lag . . . The charts show clearly that all records rise and fall together within reasonable limits and that the time lag of the recorder rarely exceeded one minute." One wonders what type of recorder was used in this comparison.

The author concludes with the remark that "It seems desirable that any standards . . . should provide for some correlation between . . . recorder installed within the plant and observations made of stack discharge." With this the writer disagrees. Observations of stack discharge are too erratic to be used in technical work. It seems well-nigh hopeless to secure the two types of data "on a comparable basis."

C. Harold Berry.[5]

To the Editor:

The determination of smoke density is one of the more troublesome problems confronting engineers. The layman judges this density by the appearance of the gas mass leaving the top of a chimney. He decides its density from appearance only with no regard to chimney diameter, condition of sunlight, or character of background. Unfortunately, the Ringelmann chart, based upon such visual observation, has become the standard means of measuring smoke density by the administrative officials of smoke-regulation departments. The injustice of such measurements has been recognized, but up to the present time no enforcement department has endeavored to set up a more rational standard of smoke measurement.

The paper describes attempts made to provide photoelectric means of measuring smoke density in a breeching that will give readings corresponding to those made by Ringelmann or other methods at the chimney outlet. The method described is an admirable improvement over earlier methods of optical observation, but it may be criticized on the basis that it perpetuates an incongruous method of

[1] "Smoke-Density Measurements," by H. E. Bumgardner, Mechanical Engineering, August, 1938, pp. 610–612.

[2] Mechanical Engineering, March, 1933, page 200.

[3] "Inadequacy of the Ringelmann Chart," by Lionel S. Marks, Mechanical Engineering, September, 1937, pp. 681–685.

[4] *Power*, October, 1932, page 197.

[5] Gordon McKay Professor of Mechanical Engineering, The Graduate School of Engineering, Harvard University, Cambridge, Mass. Mem. A.S.M.E.

smoke measurement and, further, that the equipment requires individual experimental adjustment for each chimney.

The writer has at other times advanced the plea that smoke measurement should be placed upon a standardized scientific basis. Its density should be measured by its obscuration of light of a standard brilliancy when the smoke stream is of a standard thickness, say one foot. This would correspond to Mr. Bumgardner's plan provided the space between the ends of the sleeves in Fig. 3 were one foot. Such measurements would be independent of stack diameter, daylight variations, weather conditions, or background of observation. The standards of density could be readily checked by the methods outlined in the paper or by other standardizing means. The scale of density from 0 to 100 used by the author of the paper is preferable to the use of Ringelmann numbers for the reasons which he states.

The writer noted in British central stations visited last summer that a photoelectric smoke-measurement device was installed on the boiler operating panel of all new boilers and was thus under the direct observation of the operating engineer. While this device may have defects due to variable voltage and other causes, the operating engineers all stated that it was proving an effective aid toward the diminution of smoke. The writer was also given to understand that British administrative authorities were considering absolute standards of smoke density rather than empirical observational measurements.

The increasing use of flue-gas washing has introduced another factor into the problem. The gases leaving the washers are generally saturated with moisture which, under certain weather or washing conditions, forms a fog-like vapor. Such vapor may obscure transmitted light quite as fully as would solid particles. The dense vapor plume from the top of the stack may under certain light conditions appear quite dark, although constituted principally of fog particles; and Ringelmann observations on such a discharge would thus be quite misleading. It may be further noted in connection with certain large British stations that the vapor plumes which may extend for considerable distances are more noticeable features of the upper air than the dry gases from most American plants. One would conclude from these remarks that smoke-density measurements, as we understand them, should be made upon the dry gases alone. Wet washed gases will require some other standard of measurement.

It would seem to be a proper function of the A.S.M.E. to sponsor the establishment of absolute standards of smoke measurement and to advocate their adoption by the smoke-prevention bureaus of our cities.

Mr. Bumgardner has done the profession a real service by calling attention to the desirability of a new scale of density, by pointing out the lack of logic of a system of measurement that neglects consideration of depth of smoke cloud, and by directing attention to the problems and advantages of photoelectric smoke-measurement methods.

A. G. CHRISTIE.[6]

TO THE EDITOR:

The author refers to a demonstration made with an elliptical glass container containing water to which a few drops of ink have been added. This demonstration is not convincing as a dark liquid in a glass container does not give the same effect as a smoke stream. The two are not comparable. When a qualified smoke inspector makes a stack reading, he observes the edges of the smoke stream from that stack, as well as the center. To a trained inspector, No. 3 smoke is No. 3, no matter what the size of the stack.

Table 1 and the scale shown in Fig. 1, are arbitrary. Both are based on the assumption that the Ringelmann chart applies only to a column of smoke of 5 ft diam. Despite the fact that the scale was published in "A.S.M.E. Power Test Code for Smoke-Density Determinations," it is only an assumption. The Ringelmann chart is not used in this manner by the U. S. Bureau of Mines nor by any smoke-regulation department except those of Boston, Mass., and Columbus, Ohio. According to the table, No. 1 smoke from a 25-ft-diam stack, would have a density of 67 per cent. To a smoke-abatement engineer, this seems ridiculous.

Apparently Mr. Bumgardner tried to adjust smoke recorders so they would give records comparable with smoke densities shown in Table 1. If I have interpreted his contentions correctly, these results would be totally different from records made by trained smoke inspectors. If my interpretation is right, what use could be made of the records of such smoke recorders? If a plant operator is to make any use of his smoke indicator or recorder, the records of the instrument should compare favorably with those made by a smoke inspector.

Manufacturers and distributors of smoke indicators and recorders inform me that the instrument on each installation is calibrated to show the same smoke density as that observed by an inspector. Tests made on one installation in Hudson County, N. J., show that the densities recorded by the instrument were within 3 per cent of the average of observations made by two smoke inspectors.

The purpose of a smoke indicator is to indicate immediately whether smoke is being made. The most important requirement is to give prompt warning of a possible violation of any existing smoke ordinance in the territory. It has been my experience with over a hundred installations, that such instruments give such warning consistently, provided they are maintained and kept in operating condition. In other words, smoke indicators serve the purpose for which they were intended.

Fig. 5 in the paper gives a comparison of the observations of two observers and the record of a smoke recorder. As noted by the author, the instrument "recorded correctly at the lower densities but the readings were low when the density exceeded about 30 per cent." In many instances, the difference exceeds 20 per cent in smoke density. The instrument was most inaccurate at the very points where it was needed the most. When the density is 40 per cent or more, which is a violation of many smoke ordinances, the smoke meter should agree with the observations of a smoke inspector. It is at such times that the operator should know immediately that his stack may be violating the ordinance. If the instrument reads too low, it is practically useless.

In making up Table 1, why was the dividing line on stacks put at 5 ft diam? In any district, there are several times as many stacks less than 5 ft diam than there are stacks of greater size. In this whole argument, we must not lose sight of the fact that the volume of smoke is much greater from a larger stack. For example, let us compare a stack of 1 ft diam with one of 25 ft diam. If each stack is emitting smoke of No. 3 density at the same velocity the volume of the products of combustion and hence the volume of smoke from the large stack is 625 times that from the small stack.

To those of us who have had long experience in practical use of the Ringelmann chart, it seems all wrong to assume that it is based on a stack of 5 ft diam. Our contention is that No. 3 smoke is No. 3, no matter whether from a 1-ft or a 25-ft stack.

WILLIAM G. CHRISTY.[7]

[6] Professor of Mechanical Engineering, Johns Hopkins University, Baltimore, Md. President and Fellow A.S.M.E.

[7] Charge Smoke Regulation Department, Hudson County, N. J., Jersey City, N. J. Mem. A.S.M.E.

TO THE EDITOR:

Recording instruments, whether they be flowmeters, CO_2 meters, recording stack thermometers, or smoke-density meters, are for the aid of the operating personnel. They should therefore tell a true story. We all know that they can be made to read anything. In fact, a CO_2 recorder may be adjusted to register 20 per cent CO_2, which is impossible.

As instruments are for the aid of the engineer and operator, it is desirable to have them read as nearly correctly as possible and show true conditions, otherwise they are useless and a waste of money. Therefore a smoke indicator should give readings of the smoke density which are the same as would be made by an inspector observing the stack, and there is no reason why the indicator cannot be so adjusted.

A trained smoke inspector can certainly take a representative smoke reading by a standard method, such as the Ringelmann-chart method, on any size stack, large or small. The records of many smoke departments will prove this. After a smoke indicator is installed in a stack, it should be adjusted to tell the fireman exactly the same story that the stack tells to a smoke inspector. If the smoke indicator does not do this, it is not adjusted correctly, does not tell the true story, and is not functioning properly. This is particularly the case, if it reads low on Nos. 3, 4, or 5 smoke, the kind a smoke inspector or fireman should be most interested in stopping.

If the particular smoke indicator in question is of such a nature that it cannot be adjusted to record correctly throughout the entire range of from 0 to 100 per cent smoke density, it is more important to have it read as nearly correctly as possible at from 40 to 80 per cent smoke density than at from 0 to 40 per cent. In other words it should read correctly in the range where the smoke is a violation of the local ordinance.

The paper goes into great detail to show that smoke indicators, when installed, should be specially adjusted and calibrated for each size of stack, under the assumption that the Ringelmann scale "applies only to a smoke column the diameter or thickness of which is 5 ft," that is for all practical purposes, the smoke from a stack of 5 ft inside diam. This is an incorrect assumption. Fig. 5 shows clearly, disregarding the time lag, that "although the instrument recorded correctly at the lower densities, the readings were quite low when the density exceeded about 30 per cent." This is exactly the opposite of what is desired in practical smoke abatement.

In smoke-abatement work, a smoke inspector will go by a plant that is making smoke of 10 to 20 per cent density. If a stack is making No. 2 smoke, 40 per cent density, or greater, he will go into the plant to investigate conditions of combustion. This is the reason that it is more important for a smoke meter to show or to record accurately from 40 to 80 per cent rather than from 0 to 40 per cent.

Assuming a time lag of about one minute to be correct, Fig. 5 of the paper shows comparisons between average smoke density observed and recorded as shown in the table herewith.

	Smoke density		
Time, min	Average observation, per cent	Recorded, per cent	Difference, per cent
2	80	62	18
6	70	50	20
10	85	58	27
16	38	22	16
31	8	10	2
36	30	18	12
37	40	28	12
52	10	8	2
54	35	20	15
55	45	23	22
57	50	30	20
58	80	60	20

Mr. Bumgardner admits that this record is from an "unsatisfactory recorder." The difference shown is entirely too great and amounts to about 20 per cent smoke density in cases of high readings. In other words, the smoke recorded is a whole number lower on the Ringelmann scale than the smoke observed.

In reading smoke, trained smoke inspectors observing any size stack, large or small, at the same time can come within 5 per cent of each other on the final analysis of their respective observations. We have in our files a check observation on a 7-ft-diam stack equipped with a Leeds & Northrup smoke recorder. Observations were taken by two smoke inspectors and the results checked against the smoke recorder for the same period of time. The smoke varied from 0 to no. 5 Ringelmann, or from 0 to 100 per cent density several times during the hour. The inspectors' readings and the instrument record varied alike for the hour. The results showed that the average smoke density observed by two inspectors was 50.75 per cent, while the average as recorded was 48 per cent. Such a smoke indicator is certainly more accurate and more helpful to the operating men in the boiler room than the one described in the paper.

JOHN L. HODGES.[8]

[8] Deputy Smoke Abatement Engineer, Hudson County, Jersey City, N. J. Mem. A.S.M.E.

TO THE EDITOR:

The primary purpose of a smoke indicator is to keep from making excessive smoke in violation of existing laws of the municipality in which the plant is located. There are many other instruments available for keeping the plant efficiency at the desired point so that the claim of some manufacturers that the smoke indicator or recorder can be used to keep the plant up to a certain standard should be neglected. Most cities define a violation as "equal to or greater than no. 3 of the Ringelmann chart," so it would seem that the smoke alarm should have No. 3 as its most accurate point regardless of the size of the stack or any other condition. This point can easily be checked by means of an observer having his readings synchronized with the instrument.

A smoke inspector is not particularly interested in the diameter of the stack he is observing. A violation is a violation regardless of whether it comes from a 2-ft or a 10-ft stack.

The assumption that smoke from a 5-ft stack is the standard of measurement is apparently new and I do not see any justification for it. There are many more stacks less than 5 ft than greater so why should that be taken as the standard.

While it has been admitted many times that the Ringelmann chart has many defects, still it is workable and has stood the test in the courts. It would of course, be impractical to require a smoke recorder to be installed in every plant.

We have obtained excellent results with smoke alarms operating on the same principle as the recorder. There is one building directly across from our office which was a frequent violator in the winter of 1936–1937. A smoke alarm was installed and there has not been a violation observed this last winter. Other buildings have shown the same result. It, therefore, seems to me that the desired result which is the prevention of violations, can easily be obtained without adding the more expensive recording apparatus.

While I disagree with some of Mr. Bumgardner's conclusions I think he and The Detroit Edison Company are to be congratulated on inaugurating some research work in a field which has been greatly neglected. The paper and the resulting discussion will stimulate interest and further research.

H. K. KUGEL.[9]

[9] Smoke-Regulation Engineer, District of Columbia. Mem. A.S.M.E.

TO THE EDITOR:

The author defines smoke density as "the quantity of smoke present." This

tells us exactly nothing. He does not inform us what smoke is or how to measure "the quantity ..... present." This haziness reflects the general attitude and is responsible for the present chaotic condition of smoke measurement and smoke control.

Smoke is defined in Webster's New International Dictionary as "the gaseous products of burning organic materials... rendered visible by the presence of small particles of carbon, which finally settle out as soot." If this definition is accepted, the stack gases from a pulverized-coal plant, rendered visible by the presence of fly ash, cannot be regarded as smoke. Similarly, stack gases rendered visible by a large content of steam, as in a plant in which the gases are cleaned by water washing, cannot be regarded as smoke.

Density, in ordinary scientific usage, is (1) mass (or weight) per unit volume; in photography, it is either (2) degree of opacity or (3) depth of shade. Each of these definitions has been used as the basis for procedures in measuring smoke density. Definition (1) is used in devices which determine the amount of soot in a sample of gas of known volume; (2) is used in the devices described by the author as internal-absorption types; and (3) is the justification for the use of devices such as the Ringelmann chart. Since these three procedures depend on entirely different properties of smoke, they cannot be expected to yield accordant results. Procedure (1) gives a true property of the smoke; procedure (2) will also give a true property when modified as proposed by the author; but procedure (3) gives indications which depend not only on the composition of the smoke but also on the stack diameter, the color of the sky, the wind, and other factors.

The author's investigation is concerned with a comparison of observations taken with devices of types (2) and (3). He calls attention to the following factors which affect the accuracy of the light-absorbing device: Smoke-stream thickness; proportions of transmitted, reflected, and absorbed light in the light path; reflected light from the surroundings; and constancy of intensity of the light source. The author attempts to control all these in his modification of the internal-absorption smoke indicator, but fails to observe that the appearance of stack gases is also controlled by these factors, as well as by the color of the sky, wind, and so on. The author states that observations were taken "under more or less ideal weather and wind conditions" but these are not invariably available for the smoke inspector.

The tacit assumption underlying these investigations appears to be the acceptance of smoke-density observations by Ringelmann chart or equivalent devices "under more or less ideal weather and wind conditions" as a standard. The modified internal-absorption device is then compared with this standard and it is shown that for a particular stack the indications by the two methods agreed satisfactorily; that is, it is possible to make procedures (2) and (3) agree with one another for this particular stack and under "more or less ideal" conditions.

This may have some value, but if it tends to justify the use of the Ringelmann chart or its equivalent as a device whereby the smoke inspector can determine the density of smoke issuing from a stack, it is entirely misleading. If all stacks were built to the same diameter; if the weather and wind conditions were always "more or less ideal;" if the sky were always bright blue, or white, or some other color; if there were no fly ash or water vapor; and if the smoke inspector were always an accurate observer, it might be permissible to adopt visual observation of stack gases as a standard procedure. Perhaps the celestial power stations operate under those conditions.

LIONEL S. MARKS.[10]

TO THE EDITOR:

The investigation so well set forth in the paper has served to bring up for discussion a subject that has long been smouldering under the surface. In practical smoke-abatement work there has always been the feeling that stacks of larger diameter were penalized in smoke-density readings due to the longer distance through which the light rays must penetrate.

Little official recognition has been taken of this except in the cases of Boston, Mass., and Columbus, Ohio, both of which have regulations based on stack diameter. One of the reasons why this question has been so long deferred in settlement is no doubt that numerically the large stacks, say from 12 to 20 ft diam, represent so small a percentage of the total number. Nevertheless the subject has been the basis of controversy in a great many instances and as a simple technical problem should be settled. No complaints of discrimination have been raised with reference to stacks of moderate diameter and the desirability of reaching some common ground on the question is obvious.

It is of course desirable if not mandatory that instrumental recordings and visual observations should agree in final smoke density if any system of standardization is worked out. In this connection it must be remembered that the same factors which increase the apparent smoke density in the case of indicating and recording instruments, also work in connection with visual observations.

It is a fact that long before any indicating or recording devices were developed the effect of stack diameter on visual observations was being noted. The problems in smoke abatement nowadays are more in the nature of refinements in practice and methods and they serve to indicate the substantial progress that has been made in this line of work.

Just where the point of standardization should be located or the line drawn between stacks of small and large diameter is largely a matter of experiment. In an ordinary industrial stack of, say, 5 ft diam visual observations can be conducted with a fair degree of accuracy and it seems to me this is about where the dividing line should be placed. This coincides closely with the experiments described in the present paper.

One great advantage in the case of a properly calibrated system of instrumental recordings is the removal of the human element. But aside from the human element there are other serious drawbacks in practical smoke-observation work which such a development would avoid. These are conditions due to the weather, wind direction, point of observation with respect to the sun, and so on, all of which interfere with accurate visual observations.

Mr. Bumgardner in his paper has opened the way for a more scientific attack on one of the problems long awaiting solution.

OSBORN MONNETT.[11]

TO THE EDITOR:

The author has presented a discussion of the limitations of certain methods of installation of smoke recorders of the light-absorption type and of the familiar Ringelmann chart. He has avoided the use of the mathematical relation for light absorption but it seems to the writer that the author could have shortened his argument and made his points more clear if he had used the mathematical relation as a basis for his discussion.

The mathematical expression for the relation of smoke density to the light absorption is $I/I_0 = e^{-knLD}$ where I is the intensity of the light transmitted through

[10] Professor of Mechanical Engineering, Graduate School of Engineering, Harvard University, Cambridge, Mass. Mem. A.S.M.E.

[11] Commercial Testing & Engineering Co., Chicago, Ill.

a column of smoke, I_0 is the intensity of the light with no smoke between the source and the receiving photoelectric cell, e is the base of natural logarithms, k is a constant, n is the concentration of the smoke in particles per unit of length of column, L is the length of the column, and D is the diameter of the particle. By conversion to logarithms this becomes $n = kLD \log (I_0/I)$.

It is obvious from this expression that the length of the column is as important as the concentration of the smoke particles in fixing the absorption of light by the column of smoke. The diameter of the particles is likewise important but, for all practical considerations, it is necessary to neglect this factor and to assume that the particles always remain of the same diameter.

Because the length of the column is important, the length of the column must remain constant in any arrangement of a photoelectric cell for the measurement of smoke. The writer agrees with the author that it is well to extend tubes into the stack to give a short and constant length of column.

Despite the importance of the length of the column, however, if it is once fixed, the theoretical relation between light absorption and the density of the smoke remains the same. With different lengths of columns, plotting the relation between the light absorbed and the smoke density would give a family of curves of the same shape. The practical difficulty arises from the fact that the infinity of smoke concentration for any instrument is a comparatively small finite amount. That is, the light received at the photocell should, by the theoretical relation, only fall to zero when the smoke is of infinite concentration or infinite thickness. Actually, however, with any photocell, source of light, or type of recorder for the output of the cell, the instrument will read zero light with much less than true infinite concentration of smoke or length of column. Having a given light source, a given sensitivity of photocell, and type or recorder, one must choose the length of the column to give a suitably open scale for the readings.

The use of the wire-mesh screens for calibration of the recorder is ingenious but the author does not state how adjustments are made to vary the readings for the different screens. It is the writer's understanding and experience that once the length of column, the intensity of the light, and the relation between the cell and the recorder are fixed for one absorption of light, as by one screen, the relation is fixed for all other absorptions. A more complete explanation of this would be desirable.

One can calculate the theoretical relation between the density as shown by the Ringelmann chart and the readings of a photoelectric smoke recorder if one assumes that the reading of a Ringelmann chart is that of the light transmitted through the column of smoke. Actually, this is not true as the observation by the Ringelmann method includes reflection from the column as well as the transmission and is influenced by the color of the sky.

In the work at Battelle Memorial Institute for Bituminous Coal Research, Inc., on the performance of coals on small stokers, we have used a photoelectric smoke recorder using a self-generating, Photox, type of cell. We have expressed the density of the smoke in arbitrary units in which a density of 1 is taken as the density at which 10 per cent of the light is cut off. The relation of the densities to the light cut off was calculated by the equation given before which results in a density scale that is truly proportional; a density of 10 means that there are 10 times as many smoke particles in a unit of length as for a density of 1.

To enable a translation into the more familiar Ringelmann-chart densities a calibration was made by comparison of the readings of the recorder with the observations of a trained observer on the smoke as it issued from an 8-in-diam stack. Table 1, herewith, taken from a figure which has been published in Technical Report No. 1, part II, of Bituminous Coal Research, Inc., shows the relation obtained.

TABLE 1 CALIBRATION OF SMOKE CONCENTRATION

(8-In-Diam Stack, Clear Sky)

Smoke density in concentration numbers	—Ringelmann numbers— By test	Theoretical
0	0	0
5	1.3	2.0
10	2.4	3.2
15	3.2	4.0
20	3.8	4.4
30	4.5	4.8
40	5.0	4.9
∞	...	5.0

The test values of Ringelmann numbers were lower than the theoretical except at the ends of the scale.

Data from photoelectric recorders are undoubtedly better than readings by the Ringelmann chart because the recorders can operate night and day without an observer, provided that the instruments can be given frequent attention. Smoke-inspection departments of cities, however, can probably never expect to require them in every plant.

The Ringelmann-chart method may be somewhat inaccurate, but for purposes of inspection and enforcement it is so convenient that it will undoubtedly continue to be used. The method may not be good for fine distinctions, but so much remains to be done in elimination of the gross offenses in smoke that fine distinctions are not at present so necessary as convenience in measurement.

RALPH A. SHERMAN.[12]

TO THE EDITOR:

Professor Berry has questioned the wisdom of having operating instruments which are adjusted to give readings agreeing with the visual appearance of the gas stream emerging from the stack. He suggests, it would seem, that a better attack on this problem would be to measure the absolute density of the smoke and to make adjustments for stack size and gas velocity by subsequent computations. If the author understands Professor Berry's suggestion correctly, he would measure smoke density by the light-absorption method but using a fixed thickness of flue-gas stream in every case and then applying certain corrections to the readings obtained. Unfortunately, such an instrument would not be very useful in a power plant since it would not indicate to a boiler operator when "legal smoke" had been exceeded. The reading of such an instrument would have to be transposed or corrected before being of any use to the operator, and no alarm device could be applied to the instrument.

Professor Berry indicates that visual determinations of smoke density at the stack discharge are subject to many extraneous influences. With this assertion the author agrees fully. However, the paper is not concerned with smoke-density measurements of the stack discharge except for calibrating purposes when these influences do not obtain to any marked extent. Likewise, the readings obtained from an instrument such as is described in the paper are unaffected by any such factors since they do not obtain. The visual observations used in adjusting the internal-absorption instrument described are obtained only when conditions are favorable for such measurements.

The smoke-density scale suggested by Professor Berry is not a consistent scale. If 20 per cent smoke density for a 5-ft thickness of flue gas is comparable to 36 per cent for a 10-ft thickness, 49 per cent for a 15-ft thickness, and 59 per cent for a 20-ft thickness, then it follows

[12] Supervisor, Fuels Division, Battelle Memorial Institute, Columbus, Ohio. Mem. A.S.M.E.

that increasing the concentration is equivalent to telescoping or emptying in succession the contents of the squares shown in Fig. 1 of the paper. Thus, it will be realized that the Ringelmann scale does not indicate the true smoke concentrations, for 20, 40, 60, and 80 per cent light absorptions do not correspond to smoke contents varying as 1, 2, 3, and 4, respectively.

Professor Berry raises the question of whether or not the recorder, the readings of which have been plotted in Fig. 5 of the paper, is to be considered accurate. The author would like to disclaim all responsibility for the remarks attached to a similar illustration which appeared in print several years ago. The author made the tests and supplied the test data while the editor of the magazine mentioned by Professor Berry printed the results and attached his own comments. Assuming that the chart readings are accurate, it is believed Professor Berry will agree, after noting the comments made by Messrs. Christy and Hodges, that the spread between the readings of the charts and the recorder is too great to justify the conclusion that the reading of the latter is accurate.

Professor Christie suggests that a thickness of flue-gas column of possibly one foot should be standardized for instruments of the internal-absorption type. Such an arrangement would not be of much help as an operating instrument since the operator would not be able to tell when legal smoke had been exceeded. Further, it would seem that the smoke-density readings thus obtained would vary somewhat depending upon the overall width of the section in the flue-gas duct system in which the one-foot thickness was taken.

Mr. Christy states that Table 1 and the smoke-density scale developed in Fig. 1 of the paper are arbitrary which is true since no such scales have been standardized as yet. Had 20 per cent smoke density been assumed as applying to a thickness of flue gas of 1 ft instead of 5 ft, the spread between the values for the smallest and largest thicknesses shown would have been much greater than that indicated in the table. Conversely, had 20 per cent smoke density been assumed to apply to a thickness of flue gas of 10 ft instead of 5 ft, the spread between the values for the smallest and largest thicknesses shown would have been much less than that indicated. The smoke-density scale was included in the paper mainly to show that the readings obtained either by means of internal-absorption-type instruments or by visual determinations are influenced greatly by the thickness of the flue-gas stream through which the measurements or observations are made.

Mr. Christy is incorrect in assuming that the instrument described in the paper is adjusted to give the values shown in Table 1 of the paper. The instrument, mainly by means of the sleeve arrangement, is adjusted to give smoke-density readings which agree with those obtained at the stack discharge.

In the original installation of the internal-absorption instrument, i.e., without the sleeve arrangement, it was impossible to adjust the instrument so that the readings obtained were in agreement with the observations of the stack discharge. Only in special cases would such agreement be apt to obtain. Probably the installation in Hudson County which Mr. Christy refers to as giving readings which were within 3 per cent of the smoke inspector's readings was one in which the smoke density was measured in a short manifold outside of the breeching or stack. In this case, the velocity of the gases through the manifold and the thickness of the flue-gas stream in the manifold might have been such as to give readings agreeing with those obtained at the stack discharge.

Mr. Hodges' questions, similar to those raised by Mr. Christy have been answered already in the foregoing.

With reference to the proper definition of smoke, raised by Professor Marks, the author likes to consider the stack discharge as consisting of cinders, fly ash, and soot; with cinders being the heavy and hard material, fly ash the lighter and softer material, and soot the smallest and softest material. For measurements by means of internal-absorption-type instruments and smoke charts, smoke density is then the degree of opacity produced by the combination of the three constituents present in the breeching or in the stack discharge.

"POINTING"
(Photograph by G. A. Hawkins shown at Photographic Exhibit of 1938 A.S.M.E. Annual Meeting.)

Professor Marks raises the question of whether satisfactory measurements of smoke density at the stack discharge can be obtained by means of the Ringelmann chart or the equivalent. Certain of the other discussers have indicated that they have been able to obtain rather accurate results during special tests which confirm the author's experience. Whether such a device is satisfactory for measurements of the stack discharge under ordinary conditions is a matter which is outside of the scope of the present paper. The fact remains, however, that the Ringelmann chart or its equivalent is specified in over 90 per cent of the present-day smoke ordinances and no other more suitable device has, as yet, been proposed.

Mr. Monnett gives some good reasons why instrumental indications or recordings and visual observations should be on a comparable basis.

Mr. Sherman has shown mathematically that the thickness of the flue-gas stream is as important a factor as the concentration in measurements of smoke density by light-absorption methods. A reference to a similar treatment has been given in the paper.

Mr. Sherman raised a question on the use of calibration screens. If the relation between the smoke density and the change in current generated by the light-sensitive cell due to the smoke is known to be linear, no screens are required. In this case the zero and 100 per cent points (i.e., when all the light and none of the light reaches the light-sensitive cell, respectively) are sufficient. Some instruments, however, have been found to be accurate near the lower and upper ranges, only to be in error in the middle or operating range. That was the case with the recorder installation the readings of which have been plotted with smoke-chart readings in Fig. 5 of the paper. To be certain that the instrument is functioning properly throughout the entire range, four screens may be used, one which gives a density reading in the lower range, one in the upper, and two in the operating range.

The author is grateful for all this pro and con discussion on what, no doubt, is a rather controversial subject.

H. E. BUMGARDNER.[13]

[13] The Detroit Edison Company, Detroit, Mich.

A.S.M.E. BOILER CODE

Revisions and Addenda to Boiler Construction Code

IT IS THE policy of the Boiler Code Committee to receive and consider as promptly as possible any desired revision of the Rules and its Codes. Any suggestions for revisions or modifications that are approved by the Committee will be recommended for addenda to the Code. to be included later in the proper place in the Code.

The following proposed revision has been approved for publication as proposed addenda to the Code. It is published below and is submitted for criticism and approval from any one interested therein. It is to be noted that a proposed revision of the Code should not be considered final until formally adopted by the Council of the Society and issued as pink-colored addenda sheets. Communications should be addressed to the Secretary of the Boiler Code Committee, 29 West 39th St., New York, N. Y., in order that they may be presented to the Committee for consideration.

PAR. P-269. In the first sentence revise "2000 lb per hr" to read "2500 lb per hr."

PAR. P-278. Revise second sentence to read:

In the case of fire-tube boilers, FOR PRESSURES NOT IN EXCESS OF 250 LB PER SQ IN., the openings in the boilers for safety valve CONNECTIONS and the outlet opening or openings of any intervening fittings shall be not less than that given in Table P-16 [for capacities determined in accordance with Par. P-274]. FOR PRESSURES IN EXCESS OF 250 LB PER SQ IN., SUCH OPENINGS SHALL BE DETERMINED TO MEET THE REQUIREMENTS OF PARS. P-269, P-270, P-274, AND P-275.

TABLE P-16. Replace proposed revision appearing in September, 1938, MECHANICAL ENGINEERING by the following:

TABLE P-16 MINIMUM TOTAL AREAS OF OPENINGS (SQ IN.) IN FIRE-TUBE BOILERS

(For safety valve connections)

Gage pressure, lb per sq in.	Boiler heating surface, square feet: 100	200	300	400	500	600	800	1000	1200	1400	1600	1800	2000	2500	3000
16	3.21	6.42	9.64	12.85	16.05	19.28	25.70	32.10	39.56	44.98	51.40	57.80	64.20	80.20	96.30
25	2.52	5.05	7.58	10.10	12.60	15.12	20.20	25.25	30.24	35.32	40.40	45.40	50.50	63.10	75.70
50	1.60	3.20	4.80	6.40	8.00	9.60	12.80	16.00	19.20	22.40	25.60	28.74	32.00	39.90	47.90
75	1.18	2.35	3.52	4.70	5.90	7.05	9.40	11.75	14.10	16.45	18.80	21.20	23.50	29.38	35.25
100	0.93	1.86	2.80	3.73	4.66	5.59	7.46	9.32	11.18	13.05	14.92	16.74	18.64	23.25	27.90
125	0.77	1.54	2.32	3.09	3.80	4.63	6.18	7.72	9.26	10.81	12.36	13.93	15.44	19.33	23.20
150	0.66	1.32	1.98	2.64	3.30	3.96	5.28	6.60	7.92	9.24	10.56	11.90	13.20	16.51	19.82
175	0.58	1.15	1.73	2.31	2.88	3.46	4.62	5.77	6.92	8.08	9.24	10.38	11.54	14.42	17.30
200	0.51	1.02	1.54	2.05	2.56	3.07	4.10	5.12	6.14	7.17	8.20	9.24	10.24	12.83	15.40
225	0.46	0.92	1.38	1.84	2.30	2.76	3.68	4.60	5.52	6.44	7.36	8.29	9.20	11.52	13.82
250	0.42	0.84	1.25	1.67	2.09	2.51	3.34	4.18	5.02	5.85	6.68	7.53	8.36	10.45	12.55

Based on formula $A = \frac{WV}{3330}$

where A = total area of openings, sq in., W = weight of steam per hr in lb, with 8 lb per sq ft of surface, V = specific volume, cu ft.

NOTE: Number and size of openings shall provide for not less than the area given. Intermediate values may be interpolated. With flanged openings, use internal area for determining diameter.

Nominal pipe size, in.	Internal Diameter	Internal Area, sq in.	Nominal pipe size, in.	Internal Diameter	Internal Area, sq in.
1/2	0.622	0.304	3	3.068	7.393
3/4	0.824	0.533	3 1/2	3.548	9.886
1	1.049	0.864	4	4.026	12.730
1 1/4	1.380	1.495	5	5.047	20.006
1 1/2	1.610	2.036	6	6.065	28.891
2	2.067	3.355	8	8.071	51.161
2 1/2	2.469	4.788			

Standard Practice for Making Hydrostatic Tests on a Pressure Part

PAR. A-22. Insert the following as new paragraph:

A-22 *Scope.* This method of test is applicable only to materials having a definite proportional or elastic limit such as most carbon and alloy steels. It is not applicable to materials with indefinite or indeterminate proportional limits such as cast iron and most nonferrous materials.* The principle upon which the test is based assumes that the most highly stressed point in the pressure part will be subjected to a permanent set when the stress at this location reaches the proportional or elastic limit of the material. Since the stress will be directly proportional to the hydrostatic pressure, the determination of the pressure which stresses the weakest point to the proportional limit will permit a calculation of the maximum allowable working pressure that will result in a safe working stress in accordance with code requirements for the ma-

* For method of testing parts made from such materials, see Par. A-32.

terial from which the part is made at the maximum operating temperature.

PAR. A-23. Same as present Par. A-22.

PAR. A-24. Same as present Par. A-23.

PAR. A-25. Same as present Par. A-24.

PAR. A-26. Same as present Par. A-25 with the addition of the following:

The pressure part shall not have been subjected to a pressure greater than the designed maximum allowable working pressure prior to making the proof hydrostatic test.

PAR. A-27. Replace present Par. A-26 by the following:

Physical Characteristics of Metal. Determine the proportional limit of the material in accordance with A.S.T.M. Specification E8-36 Standard Method of Tension Testing of Metallic Materials. It is important that this be determined from a number of specimens cut from the part tested, after the test is completed, in order to insure that the average proportional limit of the material in the part tested is used to calculate the safe working pressure. The specimens should be cut from a location where the stress during the test has not exceeded the proportional limit, so that the specimens will be representative of the material as tested. These specimens should not be cut with a gas torch as there is danger of changing the proportional limit of the material.

PAR. A-28. Same as present Par. A-27.

PAR. A-29. Same as present Par. A-28.

PAR. A-30. Replace present Par. A-29 by the following:

A-30. *Determining Maximum Allowable Working Pressure. a* Having determined the proportional limit of the weakest point of the structure, the corresponding maximum allowable working pressure may be determined by the formula:

$$P = \frac{HS}{E}$$

where P = maximum allowable working pressure, lb per sq in.,
H = hydrostatic pressure at the proportional limit of the pressure part, lb per sq in.,
S = safe working stress permitted for the material at the maximun operating temperature as determined by code requirements,
E = average proportional limit of material, lb per sq in.

b For carbon-steel material, complying with a code specification and with a minimum tensile strength not over 62,000 lb per sq in., the proportional limit may be assumed to be two fifths of the average tensile strength of the specified range. Where no range is specified, the average tensile strength may be assumed as 5000 lb per sq in. greater than the minimum. This will eliminate the necessity for cutting tensile specimens and determining the actual proportional limit. Under such conditions the material in the pressure part tested, should have had no appreciable cold working or other treatment that would tend to raise the proportional limit above the normal value. The pressure part should preferably be normalized after forging or forming.

PAR. A-31. Same as present Par. A-30.

PAR. A-32. Add the following new paragraph:

A-32. *Testing Parts Made From Material Without Definite Proportional Limit.* Pressure parts made from cast iron or nonferrous materials without a well-defined proportional limit must be tested until failure occurs by rupture. The hydrostatic pressure at which rupture occurs must be determined. If excessive leakage occurs at rolled joints or at gasketed handhole fittings, they may be seal-welded for the test to permit test to destruction, provided the welding does not materially increase the strength of the part. No deflection measurements will be necessary. The *average* actual tensile strength of the material from which the part tested is made must be determined from test specimens cut from the part tested. If this is not practicable, the tensile strength must be assumed to be the maximum of the range given in the specification for the material.

The maximum allowable working pressure may be determined by the formula:

$$P = \frac{HS}{E}$$

where P = maximum allowable working pressure, lb per sq in.,
H = hydrostatic pressure at time of rupture, lb per sq in.,
S = safe working stress permitted for the material at the maximum operating temperature as determined by code requirements,
E = average actual tensile strength from test specimens, or maximum of the range in specification, lb per sq in.

It is possible that certain designs of pressure parts may result in concentrated stresses at critical points which may be relieved by yielding of the material at these points prior to rupture, so that failure may occur at some other point and not indicate the point of maximum stress at pressures below that causing rupture. There may be conditions which would make a test to destruction impracticable. Under such conditions a special test may be made from a carbon steel material of the same dimensions and thickness as used for the material in question. This special test part can then be tested in accordance with Pars. A-22 to A-31. The maximum allowable working pressure for the part made from the material in question would be determined by using the proper value of S for the material in the formula in Par. A-30. The value of E used in the formula would be that for the carbon steel material from which the special test part is made.

SPECIFICATIONS S-17. To be revised to conform with A.S.T.M. Specifications A 83–38T.

SPECIFICATIONS S-40. To be revised to conform with A.S.T.M. Specifications A 192–38T.

SPECIFICATIONS S-48. To be identical with A.S.T.M. Specifications A 209–38T.

SPECIFICATIONS S-49. To be identical with A.S.T.M. Specifications A 210–38T.

Case Interpretations

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code is requested to communicate with the Secretary of the Committee, 29 West 39th St., New York, N. Y.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the Secretary of the Committee to all of the members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and passed upon at a regular meeting of the Committee.

This interpretation is later submitted to the Council of The American Society of Mechanical Engineers for approval and issued then to the inquirer and also published in MECHANICAL ENGINEERING.

Following is a record of the interpretations of this Committee formulated at the meeting of October 28, 1938, which were subsequently approved by the Council.

CASES Nos. 715 and 778 (Annulled)

CASE No. 836

(In the hands of the Committee)

CASE No. 864 (*Special Ruling*)

Inquiry: Will unfired pressure vessels fabricated by fusion welding under the test requirements of Pars. U-69 and U-70 meet the code provisions if the base metal is a high-strength annealed copper alloy coming within the range of composition covered by either type "A" or "C" copper silicon alloys as defined in Specification S-36 for copper-silicon alloy plates and sheets, and rods and bars as defined in Specification S-37?

Reply: It is the opinion of the Committee that high-strength annealed copper-alloy plates or sheets having the chemical composition and minimum physical properties specified in the inquiry may be used for the construction of unfired pressure vessels by fusion welding under the general requirements of Pars. U-69 or U-70. For vessels constructed under either paragraph the welding requirements and stress allowances of Par. U-69 are to apply, except that:

(1) The elongation as determined by the free bend test shall be not less than 30 per cent;

(2) The operating temperature shall not exceed 350 F; and

(3) Stress relieving is not required.

For the allowable working stresses, see Par. U-20 and Table U-4.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Design and Shop Practice

KENT'S MECHANICAL ENGINEERS' HANDBOOK. Edited by Robert T. Kent. Eleventh edition. Vol. 3, on DESIGN. SHOP PRACTICE. Wiley's Engineering Handbook Series. Fabrikoid, $5^1/_2 \times 8^1/_2$ in., 1378 pp., $5, John Wiley & Sons, Inc., New York, N. Y.

REVIEWED BY L. P. ALFORD[1]

IN REVIEWING a new edition of a work of the nature of Kent's Handbook, the usual approaches must be abandoned. It is obviously of no significance to fit such a volume into a particular niche in engineering literature. That place has long been earned, occupied, and recognized. Nor is there any constructive purpose to be satisfied by comparing in detail the present volume with its predecessor. The information sought for by one who reads a review of such a work is: What is the scope of the book? How does it treat its topics? Is it comprehensive? Is it authoritative? From the point of attack thus indicated this review has been prepared.

The book under review is one of the two volumes of the eleventh edition of Kent's Mechanical Engineers' Handbook, which originally appeared in 1895 under the authorship of the father of the present editor in chief. Preceding editions have been written for one-volume publication. In keeping with a policy, formulated by an editorial board of the publishers, to reduce the bulk to which engineering handbooks had grown, a decision was reached to publish this eleventh edition of Kent in two volumes, "Power" and "Design and Shop Practice." The volume on power[2] was published in 1936; and the volume under review, which covers only a part of the scope of preceding editions, in 1938.

The credibility and authority of the work is indicated by the experience of the editor in chief, on the one hand, and the group of collaborators, engineers, and industrialists, to the number of forty four, who assisted in the preparation of the manuscript, on the other. This group includes many who are known and recognized as the leaders in their several fields of technology.

The scope of the handbook is indicated by the list of section topics: (1) General properties of materials, (2) iron and steel, (3) corrosion and corrosion-resistant metals, (4) nonferrous metals and alloys, (5) nonmetallic materials, (6) fabricated materials, (7) strength of materials, (8) mechanism and mechanics, (9) fastenings, (10) mechanical springs, (11) rotating numbers, (12) keys, cotters, pins, tapers, and fits, (13) bearings and lubricants, (14) gearing, (15) control mechanisms, (16) vibration and noise, (17) structures and buildings, (18) industrial heating processes, (19) forging practice, (20) foundry practice, (21) the machine shop, (22) woodworking, (23) materials handling, (24) mechanical power transmission, (25) electric motors and their control, (26) miscellaneous shop equipment, (27) safety engineering, and (28) mathematical tables.

There is a minimum of duplication of material between the volume on power and the one under review and this overlap is principally in the treatment of materials of engineering and the mathematical tables.

To turn now to more detailed outstanding considerations but not to comment upon the features of each section: In section 2 the treatment of specifications for steel products and the applications of S.A.E. steels is typical of the precise, definite form in which data are organized and presented, with the purpose of making the information instantly applicable to engineering problems. This feature is one of the characteristics of the entire volume.

In section 8 is a discussion of cam design which condenses into a few pages the principles and methods of layout of the fundamental types of cams, an element of machine design which is often troublesome. In this same section the treatment of the concepts and formulas of mechanics is a satisfying example of how such fundamentals can be condensed in presentation; the table of coefficients of friction is probably the most extensive that has been published.

Section 9 gives a complete treatment of screw standards and accompanying practice; the discussion of mechanical springs, theory, properties, and design, is a new approach to this machine element. A similar treatment is given to American standard tapers and standard fits in section 12.

Section 13, bearings and lubricants, is the longest section devoted to machine elements. It presents not only common practice but also the more recently reported researches into bearing performance and lubrication. Generous use is made of typical bearing constructions, design charts, and tables of characteristics and values. Attention is called particularly to the discussion of reference rating of antifriction bearings and the accompanying bearing selection chart.

Section 14 on gearing has been rewritten and so presents a new approach compared with other treatments. It condenses the theory, design, and selection of materials for gears into 36 pages. Another section which is an addition to handbook literature is section 16 on vibration and noise. A feature of its presentation which deserves commendation is the absence of calculus computations.

In section 18 the treatment of industrial electric heating is new; section 19 gives practice on the common forging hammers and presses; section 20 deals with gray-iron foundry practice in general, and also with the production of both malleable and nonferrous castings.

Section 21 on machine shop is one of the largest in the handbook. It opens with a discussion of lathe work and single-point metal-cutting tools applied to turning operations. Here are included data on economic tool life, machinability of steels and cast irons, typical cutting speeds and feeds, and horsepower requirements for representative tools and material to be cut. This treatment is comprehensive and the information presented is in a form to be immediately useful. In contrast, corresponding treatment of planer work, milling-machine practice, and drilling is not nearly as complete. This situation, however, is not the fault of the editor in chief but is due to the lack of fundamental information in regard to these three machine-shop proc-

[1] Consulting Engineer and Professor of Industrial Engineering, New York University, New York, N. Y. Fellow A.S.M.E.

[2] Reviewed in MECHANICAL ENGINEERING, July, 1937, pp. 538–539.

esses. Particular mention is justified of that part of this section dealing with lapping and honing, and polishing and buffing, parts of machine-shop practice on which there is far too little authentic information. This section closes with a discussion of measurements, measuring instruments, and gages.

Section 22 on woodworking is another new presentation bringing together as it does information which otherwise would be difficult to find in organized form. The following section on materials handling is devoted principally to discussions and illustrations of available hoisting, conveying, and materials-handling equipment. It lacks precise information to assist in selecting the type of equipment best suited for a particular situation. In making this comment the reviewer recognizes the difficulty of organizing and presenting helpful information of this character.

Section 25 on electric motors and their control has been prepared to answer questions frequently asked by mechanical engineers who must select, install, and be responsible for the operation of such equipment. The opening pages of definitions will be found particularly helpful. Numerous tabulations of costs of equipment have been included and their value may be open to question because of the possibilities of change in prices in the years of accelerated transition which appear to be immediately confronting American engineering and industry.

Section 26 is new in its treatment of dust collection; section 27 on safety engineering is devoted principally to safeguarding and perhaps by intent does not deal with the fundamental concepts of industrial accident, the sequential steps which cause an accident, and a classification of industrial hazards. All of this information is readily available for handbook treatment.

The closing section of the handbook is devoted to mechanical tables. Here the table of common logarithms is unusually readable because of the selection of type and arrangement; the table of properties of numbers gives seven values in addition to the circumference and area of a circle of which the number is the diameter. Each of these values appears in some formula used in the book. The final tables give what appears to be a new arrangement of metric equivalents.

The index, without which any handbook is useless, occupies 78 pages and is constructed in keeping with recognized principles of indexing.

Commendation of Kent's Handbook of Design and Shop Practice, because of its background and record of preceding volumes, would be in excess of what is required of a reviewer. The thousands of copies of its predecessors that have been used by two generations of engineers have created an evaluation of worth to which words or opinion cannot add. However, in this situation a final observation is justified. The evident keynote of the entire work is practicality, the endeavor to supply factual information, and to answer questions that arise in everyday engineering work.

Trade Associations

TRADE ASSOCIATIONS IN LAW AND BUSINESS. By Benjamin S. Kirsh in collaboration with Harold R. Shapiro. Century Book Co., New York, N. Y., 1938. Cloth, 6 × 9, 399 pp., $5.

REVIEWED BY HENRY HORNOR SNELLING[3]

THIS book, as its title suggests, deals with voluntary groups formed for mutual aid wherein each unit preserves fully its individual identity. It comes at an appropriate time in view of the investigation being undertaken by the Monopoly Inquiry, headed by Senator Joseph C. O'Mahoney of Wyoming. (The less well-known but official name of that body is "The Temporary National Economic Committee.")

Clearly it has been the desire of the author to present facts fairly and to interpret the many decisions in as unbiased a manner as is possible in dealing with such controversial subjects. If there is any tendency to lean to one side or the other it is found in the author's assumption of good intentions on the part of trade associations until bad intentions are proved, and this in turn is doubtless due to a desire to "lean backward," as he himself was formerly a government aid in antitrust suits.

The introductory chapter of 25 pages is excellently written, tracing the growth of trade associations and listing in considerable detail their more usual services to their members. This is followed by an able presentation of the conflicting social philosophies that seek to modify the policies of the law concerning the permissible cooperation between competing business enterprises.

In the chapter on statistical reporting services, the author has in numbered sections carefully defined the limits beyond which the service may not go, for example, he advises that the reporting plan be free of: (1) Secrecy in reporting data; (2) "salting" of statistical reports; (3) intimate details such as names of individual purchasers; (4) suggestions for production and price policies to be followed; (5) reporting of future prices; (6) penal provisions requiring conformity; and (7) drastic or too-strict supervision of members' activities. The question of uniform cost-accounting methods is handled in a similar way, giving the general advantages, the development of legislation on this subject, and, finally, a concise set of rules which should be followed.

Two chapters are of particular interest to management engineers. These relate to the voluntary policing of unfair business practices not by the government but by the business organizations themselves, and the standardization of size, quality, terms, grading, processes, machinery, and trade practices, including credit and arbitration. The most frequently complained of abuses as listed by the Department of Commerce are cited. These are treated as a whole, the author presenting factually the causes, the effects, and particularly the reasons why these practices cannot easily be eliminated; for example, in some industries bad practices have such a grip that no one manufacturer dares abandon them without extreme risk to his business. The questions of selling below cost and of fines for violations of code practices are both treated rather fully.

The history of standardization is traced from the birth of the American Engineering Standards Committee in 1918 (now the American Standards Association) and this is followed by authoritative decisions by the courts and by the executive departments, all favorable to standardization programs which are fair and reasonable even when they do tend to increase prices, except when, for example, lower-priced products are arbitrarily eliminated to accomplish this purpose. The author lists numerous specific economic benefits to the manufacturer, the distributor, and to the consumer, resulting from the adoption of standards and simplifications.

The chapter on defensive combinations deals with efforts to cause commodities to flow in particular channels of distribution by refusal to deal with those who insist upon their independent choice. The author seems to have taken an extreme position in suggesting "where an improper and wrongful motive is absent the defendants would be exempt from liability" although it is unquestionably true the Supreme Court pronouncements of 1933 and later omit the inflexibility of the decisions of a dozen years earlier.

The conflicting legal concepts of antitrust laws and patent laws (creating monopolies) are treated under Patent Interchange. Six "chief causes of failure to use certain patents" are listed but among

[3] Senior member, Snelling and Hendricks, Washington, D. C. Mem. A.S.M.E.

them is not mentioned the fact that when an inventor discovers an ideal process he not only patents that process, but likewise patents similar but inferior methods of doing substantially the same thing, his sole reason being to protect the legal monopoly by a group of auxiliary patents which contain claims that could not be made in the major patent. Such patents are not used, it is true, but the invention is not suppressed.

A matter of interest to management engineers is the passing of the patentee's right of control over a patented article after it is sold, that is, he can neither limit its use nor govern its resale price. The latter is naturally modified materially by recent state statutes. Cross licensing is warmly supported by the author who believes "patent interchange is nothing more than a scientific and intelligent cooperation for scientific research."

Lest anyone criticize the seeming lack of sharp boundaries between good and bad in some cases it might be noted that the law is in a state of flux and even the Supreme Court sometimes reverses itself, as for example in adopting Chief Justice White's dissent in the mimeograph case as the majority opinion in the motion-picture case and the phonograph case (both decided on the same day) only five years later. Furthermore, even today, the several circuit courts of appeals differ appreciably in their interpretation of important principles, so until these perplexing questions are settled no writer may dare define too accurately the line between legal and illegal acts.

The chapters on Credit Bureaus, Uniform Basing Point Systems, Collective Purchasing Functions, and Foreign Trade are interestingly written but are not reviewed owing to their lack of general interest to engineers. The book has the advantage of opaque paper, wide line spacing for eye ease, careful proofreading, and clear printing, especially appreciated in the well-selected small type of the notes. A novel feature of the index is the ability to locate well-known decisions without knowing the official name, for example under Bathtub case, Paper Bag case, Gasoline Cracking case, will be found the legal title of that cause.

Books Received in Library

MODERN FURNACE TECHNOLOGY. By H. Etherington. J. B. Lippincott Co., Philadelphia and New York, 1938. Leather, 6 × 9 in., 524 pp., diagrams, charts, tables, $12. An explanation of the scientific principles underlying the various phases of modern furnace design and operation, and their application in achieving operating improvement. Combustion, gas flow, heat transfer, and physicochemical theories are covered, and there is a long chapter on refractory materials. Diagrams and tables of practical data are included to assist in the practical application.

PRACTICAL DESIGNS FOR DRILLING AND MILLING TOOLS. By C. W. Hinman. McGraw-Hill Book Co., New York and London, 1938. Cloth, 6 × 9 in., 171 pp., illus., diagrams, charts, tables, $2.50. The object of this treatise is to reveal some of the principles involved in the design of drilling jigs and milling fixtures and to cite practical applications for them. The treatment is concise and practical, and the book should be of value to all designers.

PRAKTISCHES HANDBUCH DER GESAMTEN SCHWEISSTECHNIK. Vol. 1. Gasschweiss- und Schneidtechnik. By P. Schimpke and H. A. Horn. Third edition, enlarged. Julius Springer, Berlin, 1938. Cloth, 6 × 9 in., 300 pp., illus., diagrams, charts, tables, 18 rm. Following a general description of the various welding processes and the properties of weldable metals comes a detailed discussion of the oxyacetylene process, including mechanical equipment and methods for particular metals. Brazing and soldering with welding equipment and autogenous welding are also covered, and various methods for testing weld seams are described.

THE RAILWAY AGE. By C. B. Andrews. Country Life, Ltd., London; Macmillan Co., New York, 1938. Cloth, 7 × 10 in., 145 pp., illus., $3. An introduction to the study of the early British railways and of the various reactions that followed. Interest is lent to the brief historical treatment of the trains, stations, passengers, and the changing attitude of the general public by the numerous illustrations, reproduced from contemporaneous prints, woodcuts, and sketches.

RECHNERISCHE VERFAHREN ZUR HARMONISCHEN ANALYSE UND SYNTHESE. By A. Hussman. J. Springer, Berlin, 1938. Paper, 8 × 12 in., 28 pp., diagrams, charts, tables, 9.60 rm. This work is intended to facilitate the use of Runge's method of harmonic analysis and harmonic synthesis by providing schedules giving greater exactness than heretofore. Schedules with 12, 24, 36, and 72 points are provided. The text explains the general principles of harmonic analysis and synthesis, the development of the methods of calculation, and the schedule method.

LES RESSORTS. Étude complète et MÉTHODE RAPIDE DE CALCUL. By C. Reynal. Third edition. Dunod, Paris, 1938. Paper, 5 × 8 in., 222 pp., diagrams, charts, tables, 35 fr. A treatise presenting formulas and graphs for the rapid determination of the physical characteristics of the main types of springs, leaf, helical, spiral, and multiples of each. There is also discussion of the effects produced by the expansion of such springs under varying conditions. Certain other special effects are also considered, and the last chapter describes nomograms with movable strips.

STEAM AND GAS ENGINEERING. By T. E. Butterfield, B. H. Jennings, and A. W. Luce. Third edition. D. Van Nostrand Co., New York, 1938. Cloth, 6 × 10 in., 490 pp., illus., diagrams, charts, tables, $4.50. A comprehensive textbook on the subject, covering combustion, fuels and fuel-burning equipment, types of power plants and engines with their mechanical accessories, and refrigeration. Thermodynamical theory is considered as each particular subject is discussed. Practical problems are included.

STRUCTURE OF STEEL. By E. N. Simons and E. Gregory, with an introduction by F. C. Lea. Prentice-Hall, New York, 1938. Cloth, 5 × 8 in., 115 pp., illus., diagrams, charts, tables, $2. A simple, nontechnical explanation of the structure of steel, considering the various combinations of iron with carbon and other alloying constituents, the properties of the various internal structures, with the methods and heat-treatments used to produce them, and brief information on corrosion and X-ray examination.

SWEDENBORG'S TREATISE ON COPPER, 3 parts. (Opera Philosophica et Mineralia, vol. 3.) Translated into English by A. H. Searle. Published in collaboration with the Swedenborg Society by British Non-Ferrous Metals Research Association as Miscellaneous Publication No. 333. London, 1938. Cardboard, mimeographed, 536 pp., 8 × 13 in., 25 s for 3 parts. This famous work on the metallurgy of copper, by the great Swedish scientist and philosopher, was published in Latin in 1734, but has not heretofore been accessible in English. A translation, however, has laid for over thirty years in the archives of the Swedenborg Society of London and is now published in a mimeographed edition by the British Non-Ferrous Metals Research Association. The work has much to interest the metallurgist. The great bulk of it deals with the methods of smelting copper ore and refining copper then used in the various European countries, with notes from treatises by other authors. After describing the methods used for separatingsilver from copper, brass and the methods for producing it are discussed. Following this, methods of casting statues, bells, cannon, printing type, etc., are surveyed. Part two of the treatise discusses the nature of the ores of copper, their occurrence throughout the world, and the assaying of copper ore and silver. The final part considers various copper compounds and some properties of copper.

TECHNICAL PROGRESS AND UNEMPLOYMENT. Studies and Reports, Series C (Employment and Unemployment) no. 22. By E. Lederer. International Labour Office, Geneva, Switzerland, 1938. Paper, 7 × 10 in., 267 pp., tables, $1.50. (Obtainable from U. S. Branch, Washington, D. C.) This study is an analysis of the social and economic effects of technical progress, especially on unemployment and on the formation of capital. The author discusses the various forms of technical progress, the concept of technological unemployment, increasing and diminishing returns, the equilibrium of the labor market, the effects of technical progress on the economic system and the labor and capital market, the elasticity of modern monetary systems, technical improvements and the business cycle, and capital-saving technical improvements.

TENTATIVE RECOMMENDED GOOD PRACTICE CODE AND HANDBOOK ON THE FUNDAMENTALS OF DESIGN, CONSTRUCTION, OPERATION, AND MAINTENANCE OF EXHAUST SYSTEMS, developed by A.F.A. Industrial Hygiene Codes Committee. American Foundrymen's Association, Chicago, 1938. Leather, 9 × 12 in., 141 pp., charts, diagrams, tables, $4. This code prescribes rules for systems used in foundries and allied departments for the removal of dust, refuse, fumes, vapors, and so on, for health protection, safety, and good housekeeping.

A.S.M.E. NEWS

And Notes on Other Engineering Activities

A.S.M.E. Spring Meeting at New Orleans, La.

Feb. 23–25, 1939

NEW ORLEANS was chosen for the 1939 Spring Meeting of the A.S.M.E. by the Committee on Meetings and Program as a city which could offer the combined attractions of business and pleasure to a greater degree perhaps than any other in the United States. Lovely warm days, the festivities of Mardi gras, industries new and old make an ideal setup for a real Spring Meeting.

Professional Divisions Sponsor Sessions

The serious side of the program will include a series of sessions developed by the following Professional Divisions of the Society: Fuels, Management, Power, and Process Industries. There will be a Symposium on Waste Fuels, including wood, paper mill, peanut shells, bagasse, and other miscellaneous materials, that should attract widespread attention. Power development for isolated and rural industrial service and processing methods for cotton and sulphur will be other important technical features of the program.

Ordnance-matériel manufacture will be discussed by one of the chief officers of the Ordnance Department of the United States Army.

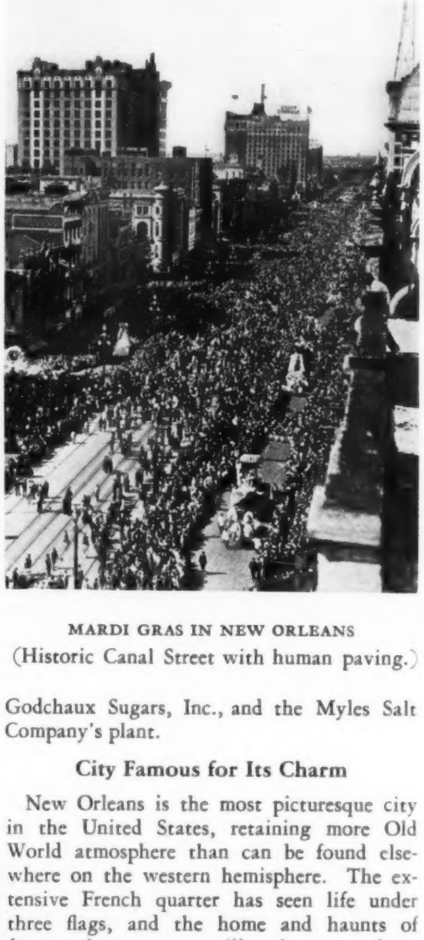
Joint Sessions With Louisiana Engineering Society

The Spring Meeting will be held at the same time and place as the Annual Meeting of the Louisiana Engineering Society which at its last year's meeting alone had a registration of nearly five hundred. Several of the sessions will be conducted jointly.

The dinner dance on Saturday evening, February 25, will climax the social events and should prove an especial attraction particularly to the visitors from the north.

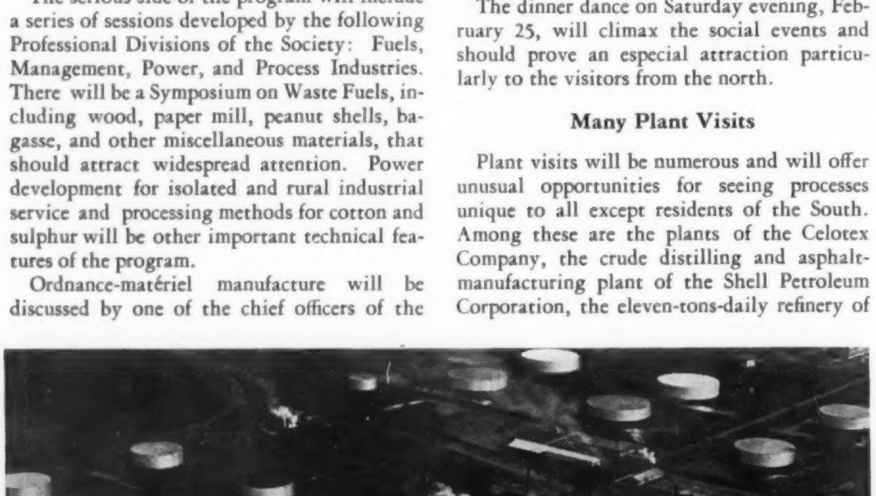
Many Plant Visits

Plant visits will be numerous and will offer unusual opportunities for seeing processes unique to all except residents of the South. Among these are the plants of the Celotex Company, the crude distilling and asphalt-manufacturing plant of the Shell Petroleum Corporation, the eleven-tons-daily refinery of Godchaux Sugars, Inc., and the Myles Salt Company's plant.



MARDI GRAS IN NEW ORLEANS

(Historic Canal Street with human paving.)



A.S.M.E. SPRING-MEETING EXCURSION PLANNED TO SHELL PETROLEUM CORPORATION PLANT AT NORCO, LA.

(Aerial view of refinery located adjacent to the Mississippi River at Norco, 25 miles upstream from New Orleans. Capacity of refinery—21,000 barrels of crude per day. Operations consist of crude distilling, liquid-phase cracking, and asphalt manufacture.)

City Famous for Its Charm

New Orleans is the most picturesque city in the United States, retaining more Old World atmosphere than can be found elsewhere on the western hemisphere. The extensive French quarter has seen life under three flags, and the home and haunts of famous characters are still to be seen and enjoyed. Artistic atmosphere and antique furniture and fixtures abound amid architecture unusual for its beauty. Famous restaurants whose cuisine is unsurpassed is one reason for not including meals in the all-expense tour which has been arranged.

Official Tour

This tour leaves several cities of the North (east of the Mississippi River) and includes the Twin Cities, Milwaukee, Chicago, Detroit, Toledo, Cleveland, Erie, Buffalo, New York, New England points, Philadelphia, Baltimore, and Washington on Saturday February 18, all meeting at Mammoth Cave, Kentucky, on Sunday afternoon. There the Star Chamber-Mummy Combination route will be taken and dinner served at the Mammoth Cave Hotel. The following day at Birmingham pipe-manufacturing plants will be visited by the men while the women will be entertained by sight-seeing, golf, cards, etc., joining the men at an evening banquet. Pictures of the

Birmingham plants appeared in the news section of the December issue of MECHANICAL ENGINEERING.

This tour is so planned that those who desire may take any return route, or may extend their stay in New Orleans, or take the Caribbean cruises, visit Florida, Texas, or Mexico. The regular itinerary appears elsewhere in this issue and a special circular is available upon request to the Secretary's office.

A representative group of the officers of the Society indicated their intention to attend the New Orleans Meeting, and many of the members who saw the motion pictures depicting scenes in Louisiana, expressed themselves as "going to be there."

In the February Issue

The complete program of topics, authors, keynote speakers, and plant visits will appear in the February issue. Meanwhile every member who even "thinks" he may go is encouraged to write the Secretary's office so that he may receive without obligation details concerning the meeting and the trip. Regular hotel rates will prevail during the meeting and rooms at the St. Charles Hotel, the headquarters for the meeting, as low as $2.50 per person, two in a room. Those who take the special train will use it as a hotel for one night at New Orleans, the night of the Mardi gras.

GODCHAUX SUGARS, INC., RESERVE REFINERY, RESERVE, LA., TO BE VISITED DURING A.S.M.E. SPRING MEETING AT NEW ORLEANS

(This plant is owned and operated by Godchaux Sugars, Inc., New Orleans, La., and located at Reserve, La., on the Mississippi River, 35 miles above New Orleans. Reserve refinery refines 2,200,000 lb of sugar per day.)

A.S.M.E. Tour to New Orleans

All-Expense Ten-Day Trip for Less Than $100 From Some Points; Includes Stopover in Birmingham, Visit to Mammoth Cave, and Mardi Gras

MEMBERS may go to the Spring Meeting of the Society in New Orleans, Feb. 23–25, 1939, in comfort on the special A.S.M.E. preconvention tour for as little as $128.30 from New York with proportional rates, depending on distance, from other cities. This price includes all meals en route (except as noted below) and while at the Mammoth Cave and in Birmingham; two-person occupancy of a Pullman bedroom or a single occupancy of a lower berth; accommodations for two persons to a room at the St. Charles Hotel in New Orleans from Wednesday to Sunday; admission to Mammoth Cave; and transfer of passengers and baggage. The cost of meals and sight-seeing in New Orleans is not included.

The all-inclusive rates from Eastern cities are given in Table 1.

Round-trip rail fare, Pullman accommodations *via* Cincinnati, and other features previously mentioned, except meals on the return trip, will apply from the following cites in the Great Lakes region, given in Table 2. If a sufficient number of members go from these cities, it will be possible to make further concessions in rates and arrangements.

TABLE 1

From	Meals, rail fare, and hotel	plus	Lower berth	or	Bedroom, 2 persons, each
Boston	$76.95		$64.45		$64.45
New York	64.90		63.40		63.40
Philadelphia	59.50		61.80		61.80
Harrisburg	58.50		60.25		60.25
Washington	51.50		60.40		60.40

TABLE 2

From	Meals (one way), rail fare, and hotel	plus	Lower berth	or	Bedroom, 2 persons, each
Pittsburgh	53.75		52.15		52.15
Cincinnati	38.75		49.25		49.25
Buffalo	64.35		(a)		(a)
Cleveland	53.95		(a)		(a)
Detroit	53.95		(a)		(a)
Chicago	42.30		50.85		50.85

(a) Regular Pullman fares to Cincinnati, thence special rates.

Because of the limited time in which to complete arrangements, members are requested to write to the Secretary's office if they intend to take part in the tour. Subject to slight modifications, the itinerary proposed for the tour is as follows:

Itinerary

A through sleeping car to New Orleans will be operated from each point where there is a sufficient number going.

Saturday, Feb. 18

Leave New York, 4:05 p.m. (*via* PRR)
North Philadelphia, 5:41 p.m., or
Leave Washington, 2:55 p.m.
Baltimore, 3:44 p.m.
Arrive Harrisburg, 6:03 p.m.

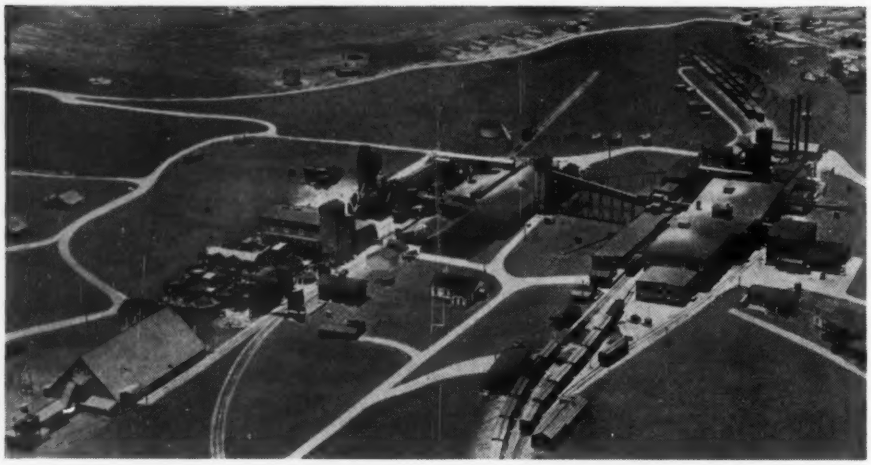
Sunday, Feb. 19

Leave Pittsburgh, 12:50 a.m.
Columbus, 5:28 a.m., and
Arrive Cincinnati, 8:15 a.m.
Arrival in Cincinnati from other cities:
Leave Buffalo, Feb. 18, 11:53 p.m. (*via* NYC) and arrive Feb. 19, 8:30 a.m.
Leave Cleveland, Feb. 18, 10:10 p.m. (*via* PRR) and arrive Feb. 19, 7:10 a.m.
Leave Chicago, Feb. 18, 11:40 p.m., and Detroit, Feb. 19, 12:15 a.m. (*via* PRR) and arrive Feb. 19, 7:30 p.m.

Leave Cincinnati, 10:00 a.m. (*via* L.&N.)
Arrive Cave City, Ky., 2:10 p.m.
Party will motor to Mammoth Cave, Kentucky. After visit to the Cave, an excellent southern-style chicken dinner will be served at Mammoth Cave Hotel.
Leave Cave City, 11:45 p.m.

Monday, Feb. 20

Arrive Birmingham, 8:00 p.m.
Party will be guests of the pipe manufac-



AERIAL VIEW OF MYLES SALT COMPANY'S PLANT AT WEEKS ISLAND, LA., TO BE VISITED DURING A.S.M.E. SPRING MEETING AT NEW ORLEANS

(Located about 150 miles west of New Orleans on the eastern shore of Vermillion Bay. Here is to be found one of the natural wonders of the world, a dome of solid salt, more than a mile in diameter and extending to an unknown depth. Mining operations are carried on at a level of 600 feet below ground where more than 4,500,000 tons of pure salt have been removed without depleting the visible supply to an appreciable extent. These underground workings are unique in that no supports or timbers are required as in the usual mining operation of this type. The temperature is constant at about 70 F, throughout the year and the walls of solid salt are so dry as to allow one to strike a match on the mine walls. The mine is ventilated with a system that assures ideal working conditions at all times.)

A.E.C. to Hold Annual Meeting, Washington, D. C., Jan. 12–14

WITH headquarters at the Mayflower Hotel, the American Engineering Council will hold its nineteenth annual assembly in Washington, D. C., Jan. 12–14. A series of public discussions, the third in the group of public forums, will be conducted during the first two days. The third day will be devoted to a business session where reports and recommendations of officers and committees will be given and officers for the new year will be elected.

The assembly will close with the All-Engineers Dinner on Friday evening, Jan. 13. Dr. Vannevar Bush, president-elect of the Carnegie Institution, will be the guest of honor upon this occasion.

The general theme of the series of forums will be the interrelation between the engineer and major social economic questions of the day in the melting pot of national consideration at the moment. The subjects at present agreed upon include, "The Economic Status of the Engineer," "The Limits of Size to Industrial Expansion," and "The Engineering Factors in National Planning."

turers. The men will visit the American Cast Iron Pipe, McWane Cast Iron Pipe, National Cast Iron Pipe, and the United States Pipe & Foundry companies, while the ladies of the group will be taken in private automobiles to see the city. Special luncheon and dinner will be given the party at the Hotel Tutwiler.

Leave Birmingham, 9:25 p.m.

Tuesday, Feb. 21

Arrive New Orleans

Special train will be parked for occupancy for Mardi gras Day, and until 12:00 noon, Wednesday, Feb. 22, when the entire party will be transferred with baggage to the St. Charles Hotel. Since Tuesday is the final day of the Mardi gras, the city will be ablaze with light and fun while parades sweep down the main thoroughfare.

In New Orleans for A.S.M.E. Spring Meeting, Feb. 23–25

Sunday, Feb. 26

Leave New Orleans, 10:15 p.m. (*via* L.&N.)

Monday, Feb. 27

En route

Tuesday, Feb. 28

Arrive Washington, 4:50 a.m.
Baltimore, 5:48 a.m.
Philadelphia, 7:22 a.m.
New York, 9:15 a.m. (Penn Station)
Chicago and other points, morning
Boston, 3:00 p.m.

Special Coupon for Tour

A special coupon for the Spring Meeting Tour to New Orleans will be found on page 28 of the advertising section of this issue. Fill it out and send it in to A.S.M.E. headquarters for further information.

Standing Committee on Local Sections Has Busy Annual Meeting Week

Meets With Council, Group Delegates, and Professional Divisions Representatives

THE STANDING Committee on Local Sections was one of the busiest of groups during the A.S.M.E. 1938 Annual Meeting week. Conferences were held with Group Delegates, with other standing committees, and with representatives of the Conference of Professional Divisions. The entire Committee was also present at the meeting of the Council of the Society.

Recommendations to Council

Members of the committee had visited as individuals a great number of A.S.M.E. Local Sections during the summer and fall of 1938 and as a result were able to compare notes on conditions in the various sections throughout the country. An important action taken as a result of these visits was the recommendation to the Council that the membership and territory of the Chattanooga Section be merged with that of the Knoxville Section, and designated as the East Tennessee Section of the Society. This recommendation was approved by the Council. The committee also recommended, upon the request of the members residing in Madison, Wis., to include that city in the territory of the Rock River Valley Section which is contiguous thereto.

In its meeting with the representatives of the Professional Divisions to discuss the development of contacts between the sections and divisions for the purpose of program making, a number of factors were brought out which should result in better technical meetings being held, especially by the larger local sections.

The committee also presented to the Council the need for activity on the part of members of the local sections leading to a careful survey of engineers well qualified for membership in the Society but who are not now associated with it. In view of the results being attained through the development of the student-member plan and the Junior-Group movement during the last five or six years, it was pointed out that the increase in membership has been among the younger engineers. The committee feels, therefore, that each local section should have a committee of its members who are well acquainted in the community and whose mature judgment would enable them to select potential members of the highest caliber.

Sixtieth Anniversary Celebration

The Sixtieth Anniversary celebration was discussed at considerable length and reports received to the effect that a large number of local sections are prepared to support this move. There will be sixty simultaneous meetings held in sixty local sections throughout the country and the projected plan provides for a national radio broadcast which will provide, at least in part, a common program for each of the sixty meetings which might otherwise have individual aspects. The date of the Sixtieth Anniversary of the founding of the A.S.M.E. is April 7, 1940.

The new program providing four national

meetings annually raised the question of having a meeting each year in the large area covered by Group VII. Because many of the sections in that area have only a limited number of members, it was decided that it will be better to meet in the seven sections of Group VII on alternate years and to schedule other meetings in the sections which form part of Group VI.

Other national meetings will be staged alternately in the South or in New England in alternate years, and in the central west annually, with the Annual Meeting itself located in the East.

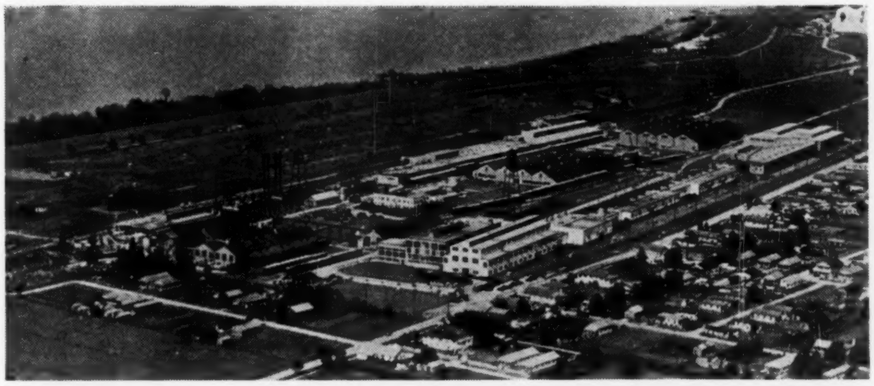
Meet With E.C.P.D.

Meeting with Dean R. L. Sackett, chairman of the Committee on Selection and Guidance of the Engineers' Council for Professional Development, the committee discussed various ways and means whereby members of the Society, through the local sections, may cooperate in the selection of a better-qualified group of engineering students.

D. B. Prentice, New Chairman

The committee elected Donald B. Prentice, who is president of Rose Polytechnic Institute, Terre Haute, Indiana, chairman for 1939.

The committee held its annual reunion dinner at the Princeton Club, when those who formerly served as members met with the active committee thus helping to maintain the continuity of policy. Adjournment was taken until the Spring Meeting of the Society at New Orleans on February 22. En route to that meeting the individual members of the committee will visit as many local sections as possible.



AMONG THE TRIPS PLANNED FOR THE A.S.M.E. SPRING MEETING IS THAT TO THE CELOTEX COMPANY PLANT AT MARRERO, LA.

(On the west bank of the Mississippi adjacent to New Orleans. The plant produces wallboard and other building materials, manufactured primarily from the fibers of bagasse, a by-product of the Louisiana sugar industry. The Celotex Company used 175,000 tons of bagasse fiber (dry basis) out of a total of approximately 675,000 tons produced from the 1937 sugar cane crop in Louisiana. The plant produceed about 310,000,000 sq ft of board during 1938. It is one of the largest industries in the New Orleans area.)

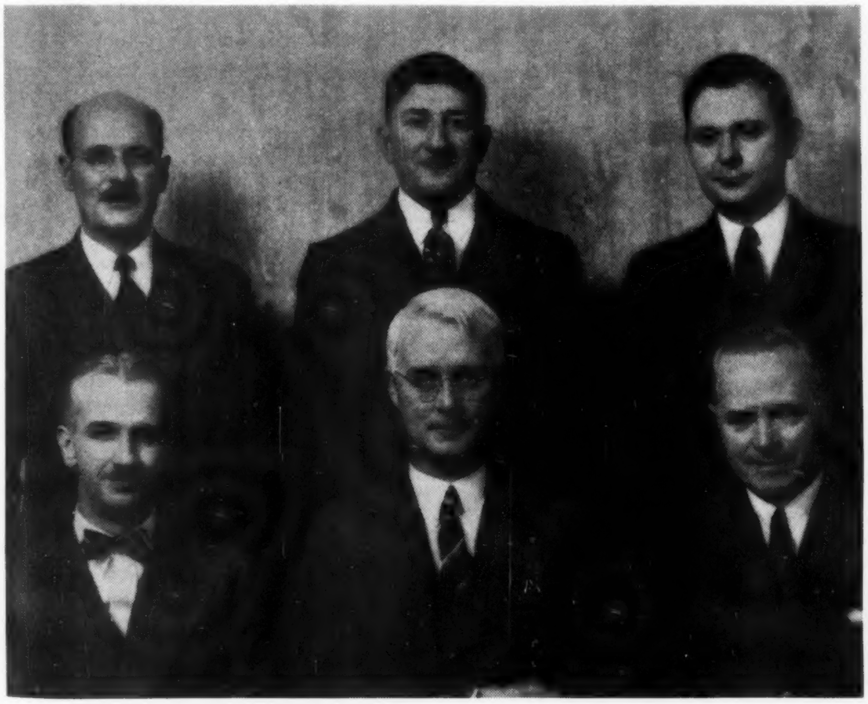
Philadelphia Section Sponsors Cooperation of U. S. Army and Local Manufacturers

Meeting on Nov. 9 With Army Officers as Speakers Attracts Attendance of 375

LEE P. HYNES, member A.S.M.E., was chairman of the special committee which arranged an "Industrial Mobilization" meeting for the afternoon and evening of Nov. 9 at the Bellevue-Stratford Hotel in Philadelphia. About 375 engineers and executives of the leading industries in Philadelphia attended.

With E. L. Hopping, member A.S.M.E., as general chairman of the afternoon meeting, S. Logan Kerr, member A.S.M.E., outlined the ordnance program. He was followed by Col. G. F. Jenks, member A.S.M.E., who described the "Development of Welded Gun Carriages." Then Lieut.-Col. L. H. Campbell discussed "Manufacturing Problems of Artillery Ammunition."

In the evening following dinner, Charles F. Bonine, member A.S.M.E., introduced the topic of "Engineering Cooperation" which was then discussed by Maj.-Gen. C. M. Wesson, U. S. Army Chief of Ordnance, and Rear Admiral W. T. Cluverius, U. S. Navy. The part played by the Philadelphia Ordnance District and the Army Ordnance Association was brought into the discussion by Philip H. Gadsden, president of the Association. Brig.-Gen. C. T. Harris, Jr., concluded the evening's program with a paper on "Plans for Industrial Mobilization."



STANDING COMMITTEE ON LOCAL SECTIONS FOR 1939

(*Standing*, left to right: John P. Ferris, Ernest Hartford, J. N. Landis. *Sitting*, left to right: A. J. Kerr, D. B. Prentice, chairman, H. L. Eggleston.)

News of Other Local Sections

Aviation Meeting of Anthracite-Lehigh

THE AVIATION meeting of the Anthracite-Lehigh Section on Nov. 22 in Wilkes-Barre was addressed by R. S. Damon, vice-president of American Airlines. After describing the operations of his company, he led a discussion in which Mayor Loveland, Postmaster Quinn, and other city officials took an active part.

ANSEMAN DRIVE IN CITY PARK, NEW ORLEANS

(In this park the natural beauty of the Louisiana landscape, with its cypress islands, massive live oaks, palmetto palms, and a variety of wild flowers has been preserved.)

Quick Freezing at Atlanta

"Quick Freezing of Foods" was the subject of the talk presented by C. T. Baker, consulting engineer, before the Atlanta Section on Nov. 28.

Travel Talk Before Baltimore

More than 300 members and guests attended the Nov. 21 meeting of the Baltimore Section to hear F. A. Allner, member A.S.M.E., and vice-president of the Penna. Water and Power Co., give an illustrated talk about his trip through the United States during the last summer.

Dry Ice in Birmingham

H. Ross Campbell, at the Nov. 28 meeting of the Birmingham Section, described the design, equipment, and process of manufacturing dry ice.

Dr. Davis at Boston

Speaking on the subject of "The Engineer of the Future," Dr. Harvey N. Davis, President of the Society, appeared before 100 members of the Boston Section at a meeting held on Nov. 10 at M.I.T.

65 Attend Buffalo Meeting

About 65 members listened to a talk on the Leipzig Trade Fair and German engineering by Mr. Wachsmuth at the meeting of Nov. 15.

Central Indiana Eats Turkey

On Nov. 18, the Central Indiana Section held a dinner meeting at Rose Polytechnic Institute in Terre Haute, Ind. After a fine helping of good Indiana turkey, the members retired to Prof. Carl Wischmeyer's workshop, where they enjoyed two papers on "Air Conditioning" by Ralph Stuart and Professor Wischmeyer. The papers were thoroughly enjoyed by the audience, some of whom had traveled 75 miles or more to enjoy the typical Hoosier hospitality of Rose Poly and Dean Prentice.

900 at Chicago Meeting

About 900 members and guests jammed the auditorium of the Engineering Building in Chicago to the walls, while 200 had to be turned away from the meeting on Nov. 8, which featured Dr. George F. Wheelwright, vice-president, Polaroid Corp., as guest speaker. After ending his talk and demonstration on "Polaroid" at 9:15, he was kept busy answering questions until 11:00.

Columbus Inspection Trip

Fiberglass manufacture, the newest and latest product of engineering, was seen at first hand by 80 members and guests of the Columbus Section on Dec. 2, on an inspection trip to the Newark plant of the Owens-Corning Fiberglas Corporation.

Connecticut Joint Meetings

Richard S. Shaw reports that joint meetings of the Hartford, New Britain, and Waterbury Sections have been tentatively arranged—for Dec. 12 in Hartford with H. S. Indge speaking on "Surface Qualities;" for January in New Britain on "Army Ordnance;" and for February in Waterbury on "Aluminum."

Greenville Hears Earle

A small group of members of the Greenville Section welcomed Dean S. B. Earle, Council Member of the Society on Nov. 11, and heard him talk on the aims and objectives of the A.S.M.E.

Florida Meets With Student Branch

In a joint meeting with the Florida Student Branch on Dec. 3, the Florida Section presented a talk on "Bridge Welding on the Florida East Coast Railway" by T. H. Gardner, and a paper on "Five Years of Aviation Progress" by F. L. Tunis, Jr., student member.

Herbert Hoover Speaks Before Inland Empire Section

On Oct. 30 at a meeting of the Inland Empire Section in Spokane, 75 members and guests heard the guest speaker, Herbert Hoover, former president of the United States, state that it is more pleasant to deal with engineers than politicians, for engineers speak of concrete rather than abstract things.

Kansas City Dinner Meeting

A dinner meeting held by the Kansas City Section on Oct. 26 was attended by approximately fifty members. Don Allshouse of the Northern Equipment Company of Erie, Pa., presented a paper on "Feedwater Regulators" outlining in detail the development, construction, and function of various regulators.

J. M. Todd at Knoxville

About 25 members were present at a meeting of the Knoxville Section on Dec. 2 to welcome James M. Todd, vice-president of the Society, who stopped off on his way to New York for the 1938 Annual Meeting.

Louisville Learns About Sun

Prof. W. L. Moore, University of Louisville, in an illustrated talk presented before the Louisville Section on Dec. 2, discussed the potential energy available in the sun's rays.

New Machine Described at Mid-Continent Luncheon

At the increasingly popular weekly luncheons held at Michaelis Cafeteria Club Rooms, Mid-Continent Section usually has an attendance of from 50 to 100. On Nov. 14, G. M. Higginson, Hawthorn, Calif., described a new machine for determining balance of pumping equipment for oil wells.

Lubrication at Milwaukee

How lubrication aided world progress and helped change the history of manufacturing and transportation, was explained to the members of the Milwaukee Section on Nov. 17, in a movie called "The Inside Story of Lubrication," shown by W. H. Thomas and R. E. Schultz, Wadhams oil-lubrication engineers.

Minnesota Members Inspect New Hydraulic Laboratory

After a dinner meeting on Nov. 9 at the University of Minnesota and a talk by Dr. Lorenz G. Straub on the University's new hydraulic laboratory, the members made an inspection of it.

North Texas Honors Juniors

Forty five of the entire membership of 91 in the North Texas Section are juniors. There-

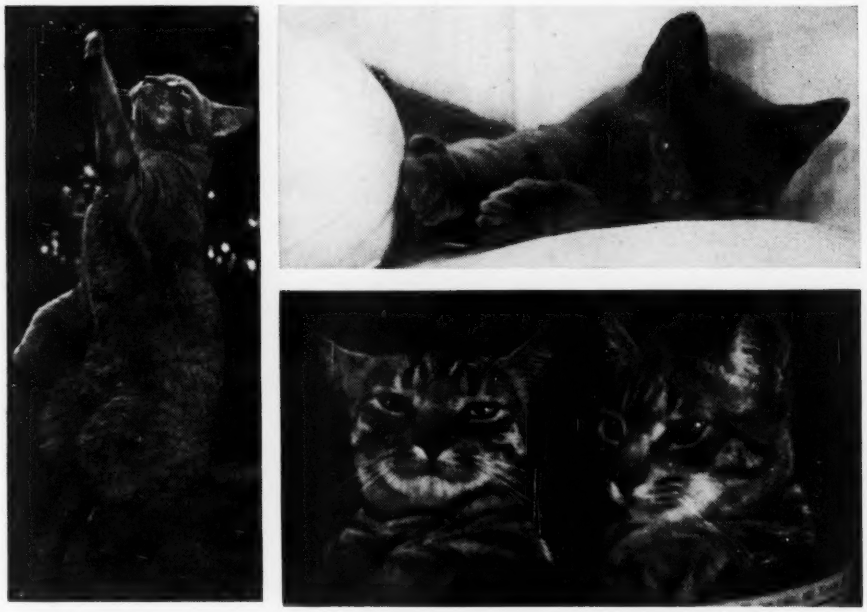
fore, it was more than proper for the Section to honor them on Nov. 18, with the following program: Cigars; Charles L. Kribs, member A.S.M.E., speaking on "Modern Considerations in Air Conditioning;" report by H. R. Pearson on Group IV Conference; and sandwiches and drinks.

Juniors Arrange Toronto Meeting

All arrangements for a combined meeting on Dec. 8 of the Toronto Section of A.S.M.E. and the Institution of Mechanical Engineers were made by the junior members. Even the speakers were all juniors and included R. G. Gillespie on "Automotive Springs and Spring Suspension Systems," H. G. Hill on "Application of Engineering Principles to Residential Air Conditioning," and D. F. Cornish on "Modern Developments in the Use of Copper and Its Alloys."

Oregon Vehicle Inspection Talk

V. L. Savage gave a demonstration talk on motor-vehicle inspection before the Oregon Section in Portland on Nov. 16. Following this, the members made a field trip to one of the state's inspecting stations to look over the equipment.



SOME TECHNICAL ASPECTS OF THE 1938 A.S.M.E. PHOTOGRAPHIC EXHIBIT
(At the left "The Old Beggar," by A. R. Parker; at the top "Ho-Ho," by C. H. Durkee; at the bottom "Muggins and Huggins," by L. F. Zsuffa.)

Steel Meeting at Providence

More than 125 members and guests of Providence Section were present on Dec. 6, to view "one of the best technicolor sound films produced to date" which was entitled "Steel—Man's Servant." Edwin Hall furnished a running commentary.

Rock River Valley Holds Two December Meetings

On Dec. 1, 108 members and guests of Rock River Valley Section assembled at the Hilton Hotel in Beloit, Wis., to hear a paper on "The Reduction of Noise," by Ernest J. Abbott. Walther C. von Fischer, secretary of the section, says in his report, "We rate the meeting as a first-rate success, due to the brilliant speech and demonstrations given by Dr. Abbott." At the same place on Dec. 13, Major John K. Christmas repeated the talk on "The Manufacture of High-Speed Tanks" which he presented in June at the 1938 Semi-Annual Meeting in St. Louis. His complete paper will be found on pages 13 to 19 of this issue of MECHANICAL ENGINEERING.

St. Louis Chairman Presents Paper

"Design and Construction of Automotive, Aircraft, and Industrial Lubricants" was the subject of the paper presented on Dec. 2, by Arthur L. Heintze, chairman of the St. Louis Section. The talk was illustrated by slides showing various lubricant group characteristics.

San Francisco Has Session on Materials Handling

J. F. Strott, assisted by R. P. Walker, junior member A.S.M.E., on Dec. 1, gave an interesting description of various types of conveyers and conveyer systems, illustrated by blackboard sketches, with practical advice concerning limitations of use and construction of the different machines.

The Boys From Syracuse

On Nov. 17, Ralph C. Paul, American Locomotive Works, discussed the history of Diesel engines before members of the Syracuse Section. Then, on Dec. 12 at 8:10 p.m. exactly, Harte Cooke, member A.S.M.E., described the design of internal-combustion engines, their fuel problems, and their practical application.

Tri-Cities Welding Meetings

W. M. B. Brady, welding specialist, General Electric Co., spoke about "Modernizing With Welding" at the Nov. 15 meeting of the Tri-Cities Section. Then on Nov. 29 under the auspices of the Junior Group, A. P. Cox, Jr., Lincoln Electric Co., reviewed "The Fundamentals of Arc-Welding Practice and the Redesign for Welded Steel Construction."

Morton Addresses Virginia

Approximately 75 members and guests were present on Nov. 18 in Richmond, Va., to hear Commissioner Morton speak on necessary legislation for boiler inspection.

Washington, D. C., Section Has Paper on Stratosphere Flying

John E. Younger, member A.S.M.E., discussed the major problems encountered in substratosphere flying before 60 members of the Washington, D. C., Section on Nov. 10. The experiments carried out on the ground made it possible for the first test flight to be undertaken.

Ordnance at West Virginia

"Ordnance and Ordnance Testing" was the topic of the paper presented before 100 members and guests of West Virginia Section on Nov. 18, by Lieut.-Col. Keith F. Adamson, U. S. Army. His talk was illustrated with slides and motion pictures.

Western Washington Get-Acquainted Xmas Party

Following a joint dinner on Dec. 8 of the members of Western Washington Section and the student members of Washington University Branch, favors and prizes were distributed and entertainment in the form of fencing, boxing, and tumbling was furnished. Following this, Mr. Hillman, home for a vacation from India, gave a talk on the conditions in that country. As a whole, the meeting was very helpful in promoting good cheer and fellowship among all those who attended.

Plastic Night at Worcester

On Dec. 13, the "Industrial and Mechanical Applications of Plastics" was discussed and illustrated with motion pictures before the Worcester Section by D. A. Munns, Bakelite Corp. Dinner at 6:45 p.m. preceded the meeting.

Youngstown Meeting

W. R. Gilsdorf, in a talk on Nov. 22, before 55 members and guests of the Youngstown Section talked on the subject of "Manufacture and Use of Fiber in the Steel Industry."

First Meeting of the 1939 Council of The

A.S.M.E. Council Conducts Official Business at 1939 Annual Meeting

Actions of General Interest Summarized

AT THE Annual Meeting of The American Society of Mechanical Engineers a new administrative year begins. The president, officers, and members of the Council who have been serving the Society for an entire year wind up their affairs and a newly elected group assumes control. It is customary, therefore, for the retiring Council to meet on Monday of Annual Meeting week and to convene in its final session on Friday, at which time the retiring president turns over the gavel to the incoming president.. Thus Friday also marks the opening meeting of the Council for a new administrative year.

During the 1938 Annual Meeting the Council met as usual on Monday morning, December 5, 1938, Harvey N. Davis, president of the Society in the chair. There were present at this meeting: William L. Batt, James H. Herron, and A. A. Potter, past-presidents; Harte Cooke, Frank O. Hoagland, Warren H. McBryde, R. J. S. Pigott, William A. Shoudy, James M. Todd, and L. W. Wallace, vice-presidents; Carl L. Bausch, Edward W. Burbank, Kenneth H. Condit, S. W. Dudley, W. Lyle Dudley, Samuel B. Earle, Walter C. Lindemann, James W. Parker, and Frank H. Prouty, managers; W. D. Ennis, treasurer; C. E. Davies, secretary; A. G. Christie, president-elect; Clarke Freeman, Alfred Iddles, H. H. Snelling, William H. Winterrowd, and Willis R. Woolrich, Council members-elect; K. M. Irwin (Finance), Donald B. Prentice (Local Sections), Francis Hodgkinson (Power Test Codes), Earl F. Scott (Professional Conduct), and Eugene W. O'Brien (Relations With Colleges), representatives of standing committees; W. L. Edel, L. E. Jermy, J. C. Parker, and M. B. Richardson, guests; and George A. Stetson, of the staff.

At the afternoon session the following, who attended the morning session, were absent: Condit, Edel, Iddles Jermy, O'Brien, John C. Parker, Prentice, Richardson, and Winterrowd. J. J. Swan, who did not attend the morning session, was present in the afternoon.

Reports for 1937–1938 Approved

Reports of the Council and of the Finance Committee and of the standing and other committees covering activities for the fiscal year, 1937–1938, were presented and accepted. The Council and Finance Committee reports will be found on pages 59 to 70 of this issue. Printed copies of the other reports are available and may be obtained from the secretary on request.

Actions of the Executive Committee taken at its meeting on December 4 were reported by the secretary. A summary of these actions follows:

The Executive Committee of the Council met on Sunday, December 4, to transact routine matters of business. This included a painstaking review of the financial statement for October of the current year and action on the recommendations of the Board of Review on resignations. A procedure for establishing advisory committees for the Committee on Admissions was also agreed upon.

New Committee on Membership Development Proposed

The Committee on Local Sections recommended that the past-chairman of the Committee on Local Sections be designated by the president as one having a direct responsibility to increase Society membership. Following a discussion of this suggestion the Council voted to approve in principle the recommendation that a new committee on membership development be set up, and that this recommendation be referred to the 1938–1939 Council.

John C. Parker addressed the Council and made inquiries concerning the time and place of the 1938 Annual Business Meeting.

Seven Senior Councilors Report

Because of the broad extent in geographical distribution of the local sections of the Society and the impossibility of arranging visits by the president, to all parts of the country, the Society has adopted the policy as designating seven of its vice-presidents as personal representatives of the president for the purpose of maintaining close contact between the Council and the sections. Reports of the seven "Senior Councilors," so-called, who maintain these contacts, were therefore called for by President Davis.

Reporting for Group I, S. W. Dudley called attention to the importance of the programs of junior groups in Connecticut. The efforts of these groups, said Dean Dudley, are directed largely to the coordination of junior programs and joint meetings. All groups have been moving successfully toward a continued series of interchanges among those sections. He reported that the Local Sections Delegates Conference for Group I had been handled with great expertness by its chairman. He had attended a meeting of the Boston Section at which President Davis gave an address, and reported that the meeting had been well-attended by junior as well as older members. In his opinion the junior movement particularly had assumed a thoroughly sound and active form in the sections throughout New England.

K. H. Condit said that Group II, which consisted solely of the Metropolitan Section, was eminently capable of taking care of its own affairs and therefore needs no guidance from its senior councilor. He had addressed the student branch at Pratt Institute, Brooklyn, and had thoroughly enjoyed the experience.

Since the previous meeting of the Council, said Harte Cooke, he had attended a dinner meeting of the Plainfield (N. J.) Section as senior councilor for Group III, where he

American Society of Mechanical Engineers

found the section in very good shape. On December 1, he reported, he had attended a joint meeting of Drexel Institute with the electrical engineers. He said that the student branch at Drexel seemed to be composed of an alert group of young men.

In his report E. W. Burbank called attention to the fact that Group IV consists of such a large territory that one man finds it practically impossible to cover it. During the last year he had been fortunate in having the able assistance of Messrs. Todd, Earle, Woolrich, and O'Brien, to whom he voiced his appreciation. He said that he had made a number of visits to sections since the Semi-Annual Meeting, including the local sections conference of Group IV. He reported finding the activities in the sections comprising the group to be progressing satisfactorily.

R. J. S. Pigott reported that the sections in Group V had not made many calls for his services, but that he had given a few addresses. It was his impression that the sections comprising the group were in a healthy condition. In many cases he had been asked questions about headquarters. His next speaking engagement was scheduled to take place after the termination of his duties as senior councilor.

Because of handicaps he had faced during the year, said W. C. Lindemann, he had been unable to take trips that carried him outside of his own city. To the affairs of the Milwaukee Section, however, he had devoted much time. The junior members were "live wires," he reported, and had proved helpful and valuable in the section's affairs. He praised the quality of the section's programs during the last two years.

L. W. Wallace, who served as alternate for Mr. Lindemann, reported that he had given a few addresses during the fall, that the Chicago Section was functioning splendidly, and that he had about four speaking engagements for the first three months of 1939.

Reporting for Group VII, W. Lyle Dudley spoke of the good fortune of Los Angeles in acting as host to the Spring Meeting and to the Group Conference. Student branches were assuming considerable importance on the Pacific Coast, he said, because of the large registrations in the universities there. He hoped the Society was taking cognizance of the juniors. The student members, he reported, were doing constructive and permanent work, and members on the Pacific Coast were proud of the junior movement. He acknowledged with appreciation the invaluable aid given by Messrs. McBryde and Prouty.

President Davis reported that he personally had visited ten student branches and had attended one student branch conference. He was greatly impressed by the vigor and importance of these student branches. The papers at the conferences, he said, were uniformly good and the students seemed to be getting an extraordinary amount of pleasure and profit from the Society.

Following the reports of the senior councilors, the secretary emphasized the fact that their visits and activities were still in the experimental stage and that every step should be taken to strengthen responsibilities and contacts with local sections and student branches.

Mr. McBryde attested to the value of the visits to the sections on the Pacific Coast made by the president and the senior councilor for Group VII. He also spoke in high praise of the work of Ernest Hartford, assistant secretary, and his remarks were warmly seconded by Mr. Wallace.

Resolutions on Death of Paul Doty

Resolutions on the death of Past-President Paul Doty were read and adopted. (The text of the resolutions will be found on page 42 of this issue.)

Greetings From John A. Hunter

A letter from John A. Hunter, of Boulder, Colo., expressing his regret at being unable, because of ill health, to attend the 1938 Annual Meeting, was read, and the secretary was asked to reply by a telegram, expressing the wishes of the Council for Mr. Hunter's speedy recovery.

Eight Fellows Elected

As a result of a secret ballot, the following were declared elected fellows of the Society: Sterling H. Bunnell, Mayo D. Hersey, John Price Jackson, Gottdank L. Kothny, R. J. S. Pigott, William F. Ryan, S. Timoshenko, and Magnus Mowat. Following the election there ensued a discussion of the procedure for obtaining candidates for promotion to the fellow grade of membership. The Council also voted to initiate action leading to a constitutional amendment which shall exempt members who are dues-exempt and who transfer to the fellow grade from payment of a transfer fee.

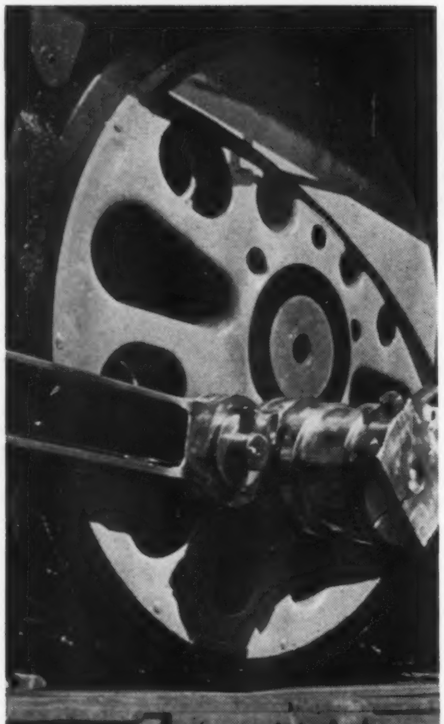
Procedure for Selecting Honorary Members Adopted

As a result of a discussion of a report submitted by the special Committee on Procedure for Honorary Membership, the Council voted to approve the revised report, and to amend Article B4, Par. 5, to provide for a lapse of only 21 days between the time of mailing a ballot on honorary membership and the closure of such election, instead of the 60-day interval now required.

The Special Committee on Procedure for Honorary Membership consisted of James H. Herron, chairman, L. P. Alford, S. B. Earle, and R. J. S. Pigott. The first provision of the report was modified by vote of the Council and dealt with the assignment of the task of making preliminary investigations of the records of proposed honorary members. As revised by the Council, the recommendation of the special committee provides that the supervision of preliminary investigation of applications for honorary memberships be assigned to the Committee on Medals, under the supervision of the Board of Honors and Awards. The report further recommended that honorary membership be not confined to members of The American Society of Mechanical Engineers, that "the committees endeavor to stimulate interest in honorary members, the quota not to exceed five per year . . .;" and that "distinguished engineers from abroad be seriously considered . . ."

Committee on Economic Status Asks Guidance

The Council received a report which was entitled "Program: Committee on the Eco-



"SPEED FOR MILWAUKEE ROAD"
(Photograph by E. S. Thompson shown at the Photographic Exhibit of the 1938 A.S.M.E. Annual Meeting.)

nomic Status of the Engineer, A.S.M.E.," and members of the Council were asked to send comments on the report to the committee for its guidance.

The report, which is too long for publication at this time, reviewed the history of the committee which brought out, in 1931, the study of the 1930 earnings of mechanical engineers, and, as a result of studies in other fields, joined in the formation of the Engineers' Council for Professional Development.

The aims of the present committee are set forth in the report, and special procedures which the committee might follow are listed. The report concludes with a list of five projects which, the committee feels, it might appropriately undertake. These involve: a study of unionization in the mechanical-engineering profession; interpretation of earnings study of the U. S. Bureau of Labor Statistics; a procedure for bringing young men to the attention of the higher officers of the organizations in which they are employed; and "action leading to the formulation of official policy by the Society's Council concerning relations between employer and employee and between superior and subordinate when both are professional engineers."

Chattanooga Merged With Knoxville Section

Upon recommendation of the Committee on Local Sections the Council voted that the membership and territory of the Chattanooga Section be merged with that of the Knoxville Section and designated as the East Tennessee Section of the Society.

Woman's Auxiliary Reports

The Council accepted with appreciation the annual report of the Woman's Auxiliary of The American Society of Mechanical Engineers, Mrs. George W. Farny, president. According to the report, the Auxiliary concentrated its efforts during the last year in developing an interest in the formation of local sections of the Auxiliary wherever local sections of the Society exist. Two such sections were organized, one at Cleveland and one at Philadelphia. Officers of the Cleveland Section are: President, Mrs. H. A. Schwartz; vice-president, Mrs. T. F. Githens; secretary, Mrs. E. R. McCarthy; and treasurer, Mrs. H. L. Spence. The section has 23 members. Officers of the Philadelphia Section are: President, Mrs. Coleman Sellers, 3d; secretary, Mrs. Charles Coleman Jones; treasurer, Mrs. J. S. Morehouse. The Philadelphia Section has 18 members.

For the Education Committee, Mrs. Roy V. Wright, chairman, reported a balance on hand, Nov. 21, 1938, of $1709.05. Receipts to the fund, amounting to $1527.89, came from bank and other interest and repayments on loans to students, sustaining memberships, gifts, transfer from general fund, and bridge parties. One loan of $150 constituted the single disbursement reported. The status of loans for students was reported as follows:

Number of loans, Nov. 30, 1938...	25
Number of loans paid during 1938.	4
Interest due and unpaid...........	$26.66
Number of students in good standing..........................	19
Number of students in interest arrears..........................	5
Number of loans not due..........	1

Faith in American Engineering Council Reaffirmed

The secretary reviewed the work of a joint committee appointed at the request of the American Society of Civil Engineers to study the aims and activities of the American Engineering Council, and read a letter from H. V. Coes which included a summary, of the replies that the committee had received, to its letter to the boards of the three participating Founder Societies asking for guidance. A thorough discussion of the support and future work of A.E.C. engaged the attention of the Council. As a result of the discussion the Council voted to reaffirm its faith in the purposes and accomplishments of the American Engineering Council, and instructed the secretary to transmit this action to A.E.C.

Following a discussion of the Parker case, the Council adjourned, to reconvene on Friday morning, December 9.

The Council Reconvenes Friday Morning

With President Harvey N. Davis in the chair, the Council met at 9:35 a.m. Friday, December 9. There were present: James H. Herron and A. A. Potter, past-presidents; Harte Cooke, Warren H. McBryde, R. J. S. Pigott, W. A. Shoudy, and L. W. Wallace, vice-presidents; Edward W. Burbank, Kenneth H. Condit, S. W. Dudley, W. Lyle Dudley, Samuel B. Earle, James W. Parker, and Frank H. Prouty, managers; W. D. Ennis, treasurer; C. E. Davies, secretary; A. G. Christie, president-elect; Clarke Freeman, Alfred Iddles, Henry H. Snelling, William H. Winterrowd, and Willis R. Woolrich, council members-elect; K. M. Irwin (Finance), Donald B. Prentice (Local Sections), V. M. Frost (Boiler Code), and S. R. Beitler (Constitution and By-Laws), representatives of standing committees; and Ernest Hartford and Leslie F. Zsuffa, of the staff.

Group Delegates Conference Reports

After passing the customary resolution of thanks in connection with the Annual Meeting, confirming the wording of the action, taken on Monday, reaffirming faith in the purposes and accomplishments of the American Engineering Council, and discussing the Society's position with respect to the Wages and Hours Act, the Council listened to a report of the actions and recommendations of the Group Delegates Conference, presented by the speaker of the Conference, Paul B. Eaton. (The substance of Professor Eaton's report is to be found on page 44 of this issue.) It was voted to receive the report with sincere appreciation, and to instruct the secretary to transmit its recommendations to the committees involved for necessary action and report to the 1939 Council.

At the suggestion of Professor Eaton the Council voted to invite the new as well as the retiring Speaker of the Conference to the December Council Meeting, and it further voted an expression of especial appreciation of the work of the Conference as evidenced by the agenda submitted to the Council. The secretary was requested to send copies of these agenda to the local sections.

Vote of Appreciation to Retiring Council Members

To Harvey N. Davis, retiring president, to Frank O. Hoagland, James M. Todd, R. J. S. Pigott, and William A. Shoudy, retiring vice-presidents, and to Walter C. Lindemann, retiring manager, sincerest appreciation for their loyalty, devotion, and cooperation in the interests of the Society was voted by the Council, following which the 1938 Council adjourned, and the Council for the administrative year 1939 convened.

1939 Council Convenes

With Harvey N. Davis in the chair, the 1939 Council of The American Society of Mechanical Engineers was called to order and its new members were introduced as follows: A. G. Christie, president; W. Lyle Dudley, Alfred Iddles, James W. Parker, and Henry H. Snelling, vice-presidents; and Clarke Freeman, William H. Winterrowd, and Willis R. Woolrich, managers. The "Presidents' Gavel" was presented to President Christie, who thereupon took the chair.

Officers and Executive Committee Appointed

The Council voted to appoint C. E. Davies, secretary, and W. D. Ennis, treasurer, of the Society for the year ending with the Annual Meeting of 1939.

It voted to appoint the following members to constitute the Executive Committee of the

Council for 1939: A. G. Christie, chairman, James W. Parker, Harte Cooke, Kenneth H. Condit, and Clarke Freeman.

The president reported the appointment of senior councilors for 1939 as follows: Group I, S. W. Dudley; Group II, Alfred Iddles; Group III, Harte Cooke; Group IV, E. W. Burbank; Group V, James W. Parker; Group VI, L. W. Wallace; and Group VII, W. Lyle Dudley.

Appointments for five-year terms unless otherwise noted, to standing and special committees were announced as follows:

Admissions: Samuel H. Libby.

Board of Honors and Awards: Dugald C. Jackson. Committee on Medals: R. L. Daugherty and William A. Hanley.

Constitution and By-Laws: Lewis H. Kenney; Junior Adviser, Carl Lindenmeyr (reappointment, one year).

Education and Training for the Industries: John Younger (reappointed for one year to fill unexpired term of John A. Randall), Sven A. Vaule (advisory member, one year).

Finance: D. C. Johnson. Council Representatives: Alfred Iddles (one year, unexpired term of K. H. Condit), W. L. Batt (two years).

Local Sections: John P. Ferris; Junior Adviser, W. F. Carhart (reappointment, one year).

Meetings and Program: N. E. Funk.

Power Test Codes: Louis Elliott, George A. Horne, Herbert B. Reynolds, Edward N. Trump, and Philip W. Swain; Junior Adviser, John Allhusen (reappointment, one year).

Professional Conduct: C. E. Waddell.

Professional Divisions: W. A. Carter; Junior Adviser, Elmo Caruthers (reappointment, one year).

Publications: C. Richard Soderberg.

Relations With Colleges: James D. Cunningham.

Research: Mayo D. Hersey and W. Trinks (four-year term replacing J. E. Gleason, resigned).

Safety: Arthur E. Windle.

Standardization: J. R. Weaver.

Board of Review: George L. Knight.

Boiler Code: D. S. Jacobus, *chairman*, E. R. Fish, *vice-chairman*, C. W. Obert, *honorary secretary*, C. A. Adams, H. E. Aldrich, H. C. Boardman, W. H. Boehm, R. E. Cecil, F. S. Clark, A. J. Ely, V. M. Frost, C. E. Gorton, A. M. Greene, Jr., W. G. Humpton, J. O. Leech, I. E. Moultrop, C. O. Myers, H. B. Oatley, James Partington, Walter Samans, S. K. Varnes, and A. C. Weigel. *Honorary members:* F. W. Dean, W. F. Durand, T. E. Durban, C. L. Huston, W. F. Kiesel, Jr., M. F. Moore, H. H. Vaughan, and H. LeRoy Whitney.

Committee on Economic Status of the Engineer: W. F. Carhart, Harold Sizer, and Warren B. Oakley, Jr.

American Engineering Council—Alternates: A. L. Davis, Sabin Crocker, T. S. McEwan, G. F. McDougall, and W. H. Clapp.

American Documentation Institute: Harrison W. Craver, representative.

Several Committees Discharged

The following special committees of the Council were discharged with appreciation and thanks: Relationship of the Society to the Accrediting Program, Procedure for Honorary Membership, Mechanical Catalog, and Westinghouse Memorial. Other special committees whose work is not yet completed were continued.

The Advisory Board on Technology and the Advisory Board on Professional Status were continued for another year, but, on its own recommendation, the Advisory Board on Standards and Codes was discontinued, with an expression of thanks and appreciation.

It was voted to continue the Special Committee on Aims and Objectives, and to empower the president to appoint the personnel.

The Council voted to express its appreciation of the services rendered by the committee on Dues-Exempt Members' Contributions and of the generosity of the "Old Guard," whose contributions had made possible the carrying out of the plans of the committee.

Membership Development Committee Reorganized

In view of the fact that the committee on Local Sections had recommended that representatives of the local sections be included in the personnel of the Membership Development Committee, thus necessitating reorganization of the committee, it was voted to discharge the present Membership Development Committee with thanks and appreciation and to reorganize it; the president being empowered to make the necessary appointments.

Society Asked to Assist in Preparing Registration Examinations

The secretary reported that the Society had been asked by the State Board of Professional Engineers and Land Surveyors, Albany, N. Y., to assist in preparing examinations for mechanical engineering. The Council pledged the cooperation of the Society and voted to authorize the Committee on Registration to work through the local sections in New York State to organize a committee to act directly with the State Board to aid in preparing examinations for mechanical engineering.

Railroad Division to Participate With Franklin Institute Meeting

Because the Railroad Division had received an invitation to participate jointly with The Franklin Institute on the occasion of the "1939 Transportation Symposium," to be held at Philadelphia, Feb. 7, 1939, with the approval of the Committee on Professional Divisions and the Railroad Division the Council voted to accept the invitation, and to appoint the following delegates, as suggested by the Railroad Division: R. S. Binkerd, D. S. Ellis, R. Eksergian, Lawford Fry, and L. B. Jones.

Student Branch Authorized in New Mexico

Upon recommendation of the Committee on Relations With Colleges the Council authorized the establishment of an A.S.M.E. student branch at the New Mexico State College of Agriculture and Mechanical Arts, State College, New Mexico.

Council to Meet at New Orleans

The Council voted to hold two additional meetings during 1939, one at New Orleans, in February, and the other at New York, in September.

By-Laws on Local Sections Amended

It was voted to adopt the following wording of Article B11, Par. 2, of the By-Laws of the Society, presented to the Council on June 20, 1938: "A Local Section shall consist of members of any or all grades." (Previous wording: "A Local Section shall consist of any or all grades, and may include other persons.")

Society Organization to Be Studied

As a result of a discussion on the need for periodic studies of the organization and management of the Society, it was voted to appoint a special committee of experts in the field of management to canvass the organization of the Society, provided no expense to the Society would be involved.

Importance of Oral Discussion at Meetings Emphasized

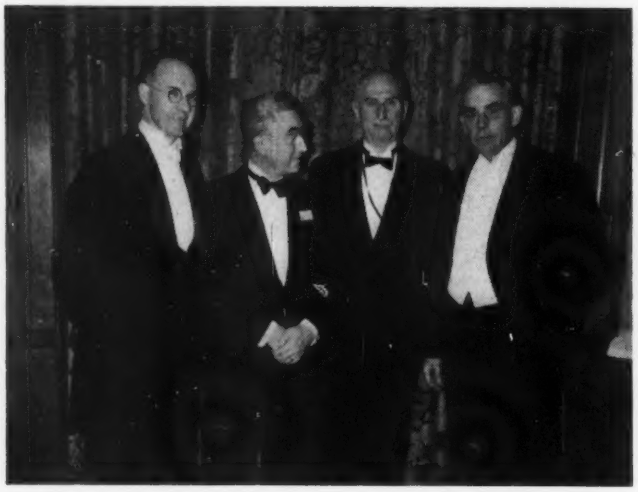
L. W. Wallace called attention to the fact that at meetings of the Society written discussions are given preference over oral discussions. In his opinion this is not a good policy. Spontaneous oral discussions should follow immediately after the presentation of the paper, he said, and written discussions at the conclusion. His comments were referred to the Committee on Meetings and Program.

Agreement With Engineering Index, Inc.

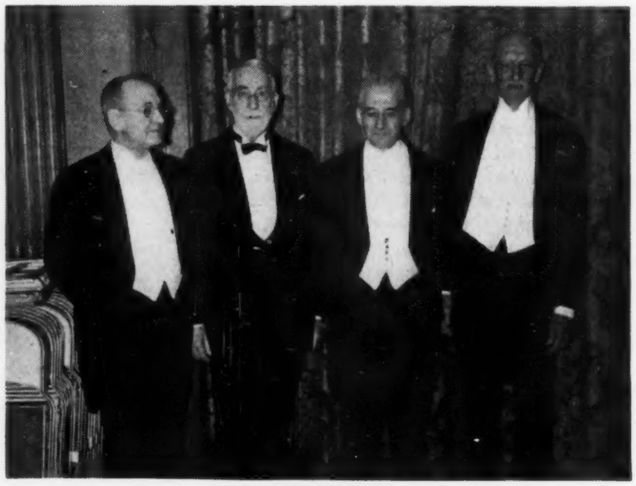
The Council voted that the agreement between the Society and Engineering Index, Inc., dated September 28, 1934, pursuant to which Engineering Index, Inc., has been operating and publishing the Engineering Index Card Service and Engineering Index Annual Volume be extended until twenty days after the entry of an order of the Appellate Division of the Supreme Court determining the appeal from a judgment of Mr. Justice Black dated June 24, 1938, in which the agreement of September 28, 1934, was voided and the Index returned to the Society.

Photographic Exhibit National in Scope

NINETEEN members from all parts of the country showed 52 prints at the Third Annual Photographic Exhibit during the Annual Meeting in New York, Dec. 5–9. They were B. L. Bailey, Niagara Falls, N. Y.; W. L. Betts, New York; B. M. Craig, Pasadena, Cal.; C. H. Durkee, New York; J. F. Guinan, Brooklyn, N. Y.; A. Hawkins, Winchendon, Mass.; C. B. LePage, New York; H. R. Limbacher, Columbus, Ohio; L. Ochtman, St. Louis, Mo.; A. R. Parker, Cincinnati, Ohio; G. W. M. Phillips, New York; E. S. Thompson, Schenectady, N. Y.; W. G. Updegraff, Elizabeth, N. J.; H. K. W. Viohl, Wilmington, Del., R. R. Weddell, Rockford, Ill.; S. Withington, New Haven, Conn.; W. C. Woodman, New York; O. F. Zahn, Jr., San Diego, Cal.; and L. F. Zsuffa, New York.

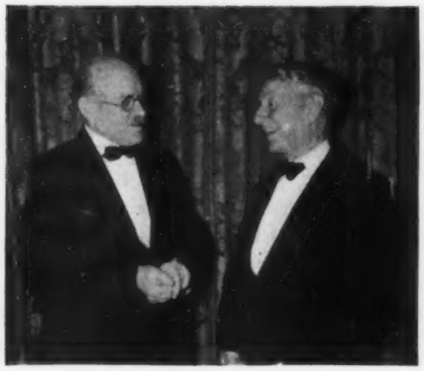


A. G. Christie, new President of A.S.M.E.; J. B. Challies, President of Engineering Institute of Canada; J. M. R. Fairbairn, Past-President of the Institute; and Dr. Harvey N. Davis, retiring President of the A.S.M.E.



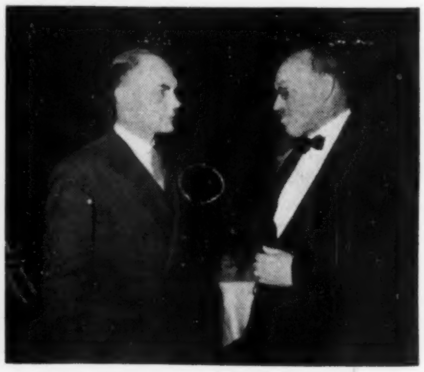
Francis Hodgkinson, 1938 Holley Medalist; Charles T. Main, Past-President of A.S.M.E.; Gerard Swope, 1938 Towne Lecturer and President of General Electric Co.; and D. S. Jacobus, Past-President of the A.S.M.E.

The Business Meeting attracted an unusually large audience



Ralph E. Flanders, Past-President of A.S.M.E. and Edw. A. Muller, Past Vice-President of Society

Carl L. Bausch, Rochester N. Y., Manager, and W. Lyle Dudley, Seattle, new Vice-President of Society

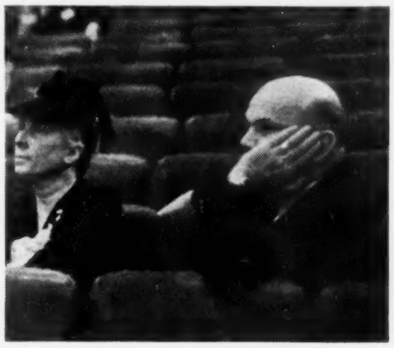


Present and past editors of "American Machinist"—John Haydock, and Ralph E. Flanders

Candid Cameraman Runs Riot

Honors Night—President Davis addresses the Society—recipients of honors on the platform

President Harvey N. Davis, introduces President-Elect A. G. Christie on Honors Night to an appreciative audience



Dr. Lillian M. Gilbreth and L. W. Wallace deeply interested in a discussion at Management Session

Jerome Lederer, secretary of Aeronautics Division, reading annual aviation progress report, Gerard P. Herrick, chairman of session

Committee on Relations With Colleges in session during Annual Meeting

Some of the participants at the maintenance luncheon and meeting

Part of the audience at the 15th Annual Meeting of the Woman's Auxiliary to the A.S.M.E.

at the 1938 A.S.M.E. Annual Meeting

Junior Group Activities

Dallas Section Honors Juniors at Get-Together

HONORING the junior members was the theme of a recent meeting and informal get-together sponsored by the Dallas Section. Almost half the membership of this section is composed of juniors, and so it seemed particularly fitting to hold a gathering designed to acquaint junior and senior members.

"Modern Considerations in Air Conditioning Problems" was the subject of the evening, and Charles L. Kribs Jr., a member of the Section, was the speaker. Out of his long experience in the field, Mr. Kribs fashioned an exceptionally interesting talk, which proved of real interest to the juniors. Another feature of the evening was a report on the Group IV Conference held in Memphis at the end of October; it was presented by H. R. Pearson. Smokes, sandwiches, and drinks rounded out a thoroughly enjoyable evening

New Group Organized at Charleston, W. Va.

ABOUT sixty or seventy young engineers from all branches of the field met November 3, under sponsorship of A.S.M.E. to organize the Charleston Junior Group of engineers. The following officers were elected: H. L. Carspecken, chairman; John Atwood, vice-chairman; and John Williams, secretary-treasurer. The organization was split into seven study groups on distillation, heat transfer, organic chemistry, metallurgy, design of pressure vessels, corporation law, and finance. Chairmen were elected for each of the groups, who will meet for study once every two weeks, with a general meeting once every two months.

Tri-Cities Juniors Hold First Meeting of Season

WITH eighteen members and friends present and Chairman Carl Hand presiding, the Tri-Cities juniors met for the first time this season on October 5, at the Rock Island Arsenal. Major action of the business meeting was a decision to hold meetings once each month in place of every two weeks as had been the schedule in the past.

Prof. Ralph M. Barnes of the University of Iowa, the speaker of the evening, was introduced by vice-chairman Paul Anderson. Speaking of the Engineers' Council for Professional Development, Professor Barnes told of its activities in guiding selection of applicants for training in engineering colleges, in rating of engineering schools, in professional training of graduate engineers, and in fostering professional recognition of engineers. In conclusion, he discussed possible programs for the Junior Group and the possibility of forming study groups.

Lubrication Film Shown to Philadelphia Juniors

LUBRICATION engaged the attention of the Philadelphia Junior Group at its November meeting, with Mr. R. A. Townley of the Socony-Vacuum Oil Co. as the speaker. He brought with him a motion picture entitled "Inside Story of Lubrication" which showed graphically the action of oil in gears, bearings, and cylinders. The accompanying sound track was devoid of technical phraseology, and combined with Mr. Townley's explanation of practical lubrication problems, made the meeting both educational and enjoyable. On the Saturday following the meeting, the Group inspected the Philadelphia refinery of the Atlantic Refining Co.

Junior Group Formed at New Orleans

NEW ORLEANS may now be added to the growing list of sections boasting Junior Groups. Definite organization was effected at a meeting of junior members of the New Orleans Section, held October 28. In addition to the 14 junior members present, several guests attended, including James M. Todd, vice-president of A.S.M.E., and K. P. Kammer, chairman of the New Orleans Section, both of whom participated in the program.

After calling the meeting to order, A. DeR. Remajon, chairman of the temporary sponsoring organization, outlined the activities being conducted nationally and locally in connection with the Junior Group idea. This was followed by Mr. Kammer's address on "The Purpose of the Junior Group," supplemented by a discussion of junior activity by Mr. Todd.

Lively interest was demonstrated by all present, as indicated by general participation in discussion of points advanced by various speakers. In the election of officers which followed, these men were chosen to guide the group in its initial activities: L. J. Cucullu, chairman; J. K. Mayer, vice-chairman, W. S. Nelson,* secretary-treasurer.

A technical program, including moving pictures and explanatory comments by Mr. Todd, concluded a successful meeting. Credit for the results achieved was due to the well-planned efforts of the temporary organization which arranged the meeting, and their work was commended by a rising vote of thanks before adjournment.

With the Student Branches

Student Members' Day at Annual Meeting Features Luncheon and Inspection Trips

MORE THAN 200 senior and student members taxed the capacity of the Hotel Astor's Rose Room at the Student Luncheon held there during the Annual Meeting on Wednesday, Dec. 7, 1938. Seated at the head table were Edward W. Connolly, winner of the 1938 Charles T. Main Award of $150; James Cunningham, new member of the Committee on Relations With Colleges, and president of Republic Flowmeters Co.; F. V. Larkin, committee member; Donald C. McSorley, winner of the 1938 Undergraduate Student Award; Harvey N. Davis, President of the Society; W. A. Hanley, toastmaster and chairman of the committee; A. G. Christie, president-elect of the A.S.M.E.; E. W. O'Brien, A. C. Chick, and H. O. Croft, committee members; and C. E. Davies, Secretary of the Society.

Davis and Christie Speak

Toastmaster Hanley, after presenting those at the head table, introduced the first speaker, Dr. Davis, who called the student members' attention to the simplified and popularized 1938 financial report of the Society, which appears in this issue of MECHANICAL ENGINEERING, as a means of obtaining a better picture of A.S.M.E. activities. Following him, Professor Christie stressed the fact that it is time for mechanical engineers to break away from old methods and practices and to develop new machinery and ideas for use of industry which in turn will help in the reemployment of millions. According to him, the logical leaders in this movement are the mechanical-engineering graduates.

Cooke Talks for Old Guard

Then, Harte Cooke, spokesman for the Old Guard Committee which donated several hundreds of dollars as prizes at regional student conferences and for the travel expenses of the 1938 student-awards recipients, invited the chairmen of all student branches who were present in New York to be the committee's guests at the Annual Dinner that evening.

Four Inspection Trips

Prior to the luncheon, some of the student members visited the Waterside generating station of the Consolidated Edison Co., while others were guests of the Sheffield Farms Co. at their 57th Street building, the largest milk-processing plant in the world. Following the

luncheon, the majority of those present went out to the World's Fair grounds. Others visited the Williamsburg Power Plant in Brooklyn.

About Branches

Akron, Arizona, and Armour

AKRON BRANCH held its first meeting in October. The aims, principles, and ideals of the Society were outlined by Prof. Fred S. Griffin, honorary chairman.

ARIZONA BRANCH at its November meeting presented W. A. Kuhneman, engineer, El Paso Natural Gas Co., who talked on "The Natural Gas Industry."

ARMOUR BRANCH had two meetings in November. The first featured A. J. Smith, Calumet Refining Co., and a motion picture on the processing of petroleum. The second, drawing a crowd of 250, was a special meeting at which Dr. S. W. Wheelwright, vice-president, Polaroid Corp., gave a talk and demonstration on polarized light.

BUCKNELL BRANCH's program for Nov. 29 was an illustrated lecture by C. J. Copley, Socony-Vacuum Co., on "The Inside Story of Lubrication."

California Banquet Meeting

On Nov. 9, CALIFORNIA BRANCH held a banquet and meeting at the Berkeley Inn. George Hayes gave a paper on the production of aircraft, Merrian Isrial described aviation instruments, and Prof. Royal A. Roberts spoke on the necessity of salesmanship and advertising in making the products of engineering profitable.

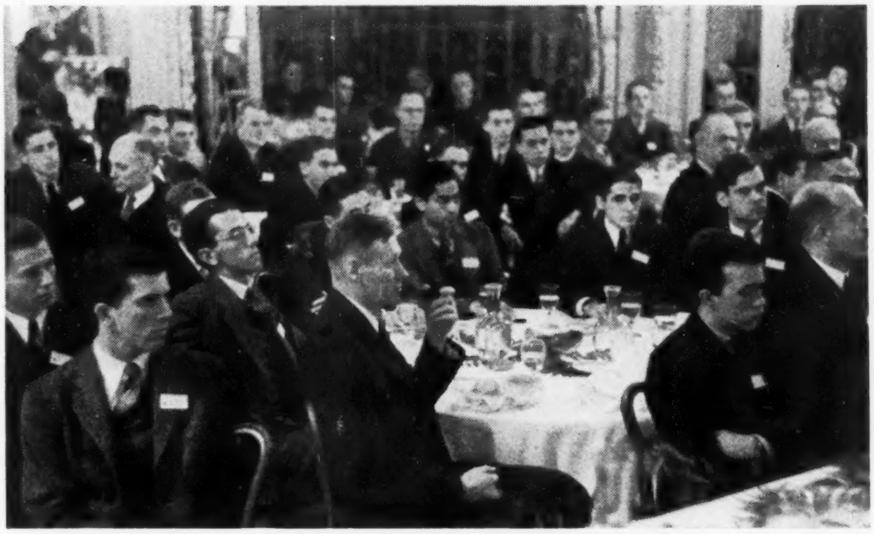
CLARKSON BRANCH held a supper meeting on Nov. 16 in Ogdensburg, N. Y., following an inspection trip to the Algonquin Paper Co. The speaker of the evening was Alfred Bartlett, chief engineer of the company, who described the making of newsprint paper.

CLEMSON BRANCH drew more than 175 students to its Nov. 2 meeting at which the B. & W. motion picture "Steam" was shown. On Nov. 18, members of the Branch made an inspection trip to the hydroelectric development of the Georgia Power Company at Tallulah Falls.

Delar

AT A.S.M.E. METROPOLITAN STUDENT CONVENTION, DEC. 2

Harvey N. Davis, President of A.S.M.E. and Stevens Institute gets his name tag from O. Schellor, Secretary of Stevens Student Branch



AFTER EATING A SUMPTUOUS MEAL, THE 200 STUDENTS AND SOCIETY MEMBERS LISTEN TO TWO-MINUTE TALKS BY HARVEY N. DAVIS AND A. G. CHRISTIE AT THE STUDENT LUNCHEON ON WEDNESDAY DEC. 7

COOPER UNION BRANCH announces its reorganization into a day and an evening division. Officers for 1938–1939 of the day division are D. Russ, M. Breitman, and A. Swenson.

$6,000,000 Cornell Program

A $6,000,000 expansion program for Cornell University was recently announced by Dr. E. E. Day, president. Dr. Day said a committee of trustees, following a study of the needs for the College of Engineering, had recommended an increase of $2,500,000 in the endowment of the college to support special professorships and increase the general level of compensation of the teaching staff. It was also recommended that $3,500,000 be spent for construction and equipment of two new buildings on the campus. The new buildings will be a college of chemical engineering and a modern materials and metallurgy laboratory. On Nov. 8, members of the CORNELL BRANCH made an inspection trip to the University's waterpower plant in Fall Creek Gorge.

DETROIT BRANCH welcomed back on Nov. 3 as guest speaker, Warren Briggs Oakley, chairman in 1935, who is now an engineer in the Diesel division of General Motors. Of course, his talk was on "Diesel Engines."

350 at Duke Meeting

Speaking on "Air Transportation and Communication," Captain Eddie Rickenbacker was the guest speaker at the Nov. 29 meeting of DUKE BRANCH. After the meeting, the 350 members of the audience attended the informal smoker at which Captain Rickenbacker greeted each one in person. In the audience were 43 members of the NORTH CAROLINA STATE BRANCH.

ILLINOIS BRANCH on Nov. 9 had R. N. Nettenstrom, general superintendent, American Forge Division of the American Brake Shoe and Foundry Co., as the speaker of the evening. His paper described "Upset Forging." The next day, members made an inspection trip to Peoria.

IOWA BRANCH had the following members present papers at the weekly meetings in November: C. N. Peterson on "Mechanical Aptitude Tests;" R. C. Richards on "Modern Methods of Mining Gold;" J. O. Wessale on "Aeronautical Safety Through Design;" L. R. Pestal on "The Aircraft Industry;" and R. G. Petranek on "Silencing of Noise of Airplane Propellers."

IOWA STATE BRANCH heard brief reports by the senior students about their recent inspection trip to Milwaukee and Chicago.

Johns Hopkins Happy Over Election of Professor Christie

John M. Wetzler, Jr., secretary of the JOHNS HOPKINS BRANCH writes, "We are all overjoyed at the election of our Professor Christie to the presidency of the A.S.M.E. and hope his term in office will be a prosperous one."

KENTUCKY BRANCH members were guests of the LOUISVILLE BRANCH at a meeting held on Nov. 18 at the latter school.

LAFAYETTE BRANCH at its meeting of Nov. 16 presented a motion picture on "Manufactured Abrasives."

LOUISIANA STATE BRANCH made a trip on Nov. 12 to the Freeport Sulphur Co. operations.

Joint Meeting in Louisville

A joint meeting of the LOUISVILLE BRANCH and the KENTUCKY BRANCH was held on Nov. 18 at the Speed Scientific School. Dean Wilkinson spoke and a technical paper was presented by R. Gray. An inspection of the school laboratories was followed by visits to the Brown & Williamson Tobacco Co. and the Henry Vogt Machine Co. Luncheon was furnished by the tobacco company in its plant cafeteria.

MARYLAND BRANCH was fortunate in having H. H. Snelling, newly elected vice-president of the Society, as its guest speaker on Nov. 16.

MORE THAN 150 STUDENT MEMBERS FROM C.C.N.Y., COLUMBIA, COOPER UNION, NEWARK COLLEGE, N.Y.U., BROOKLYN POLY, PRATT, AND STEVENS ATTENDED A.S.M.E. METROPOLITAN STUDENT CONVENTION IN HOBOKEN, N. J., ON DEC. 2 AS GUESTS OF STEVENS A.S.M.E. STUDENT BRANCH

The title of the talk was "Inventors are Catalysts."

M.I.T. BRANCH made an inspection of the U. S. Navy Yard in Charleston, Mass., on Nov. 30. More than 200 members and guests saw motion pictures on "Making an All-Steel Body" and "Making a V-Type Engine," on Nov. 8.

77 at Michigan Meeting

MICHIGAN BRANCH heard Prof. R. S. Hawley on Nov. 30 in a talk on the basic fuels of the country. It included a brief history of the use of coal and the rising popularity and demand for oil and natural gas. Present at the meeting was Prof. J. E. Emswiler, who has not been in the best of health of late. It was announced by Chairman John M. Stevens, that the Annual Roast will be held on Dec. 16.

MICHIGAN STATE COLLEGE members made an inspection trip to the main plant of the Olds Motor Co. During the month papers were presented by Julius Skene, Charles Smith, Robert Sterling, William R. Taylor, and Robert S. Tooker.

MICHIGAN TECH BRANCH members heard a paper on Nov. 9 by George Schember on "The Application of Mathematics in the Design of Chevrolet Cars and Trucks."

MISSISSIPPI STATE BRANCH at its meeting of Nov. 10 listened to a talk on "Loop Courses" by Professor Adams of the civil-engineering department.

MONTANA STATE BRANCH members saw three motion pictures at the Nov. 3 meeting. They were "The Molders," Big Deeds by GE," and "Electricity Goes to Sea."

Insulation at Newark

On Nov. 7, 75 members of NEWARK BRANCH heard a talk by Mr. Hall of the Johns-Manville Corp. on the problems found in the manufacture of insulating materials.

N.Y.U. BRANCH (evening) at a meeting held on Nov. 30 at Washington Square College had Dr. H. E. Wessman, head of the department of civil engineering, speak of his experiences in China while connected with the Ministry of Railways.

N.Y.U. BRANCH (aeronautical) sent in a report about a meeting on Nov. 16 but omitted the details as to what took place.

N. C. STATE COLLEGE members were guests of DUKE BRANCH on Nov. 29 at a meeting addressed by Captain Rickenbacker.

Novelties at North Dakota

In answering roll call at each meeting of the NORTH DAKOTA BRANCH, every member must make a statement which is of scientific interest. Another interesting innovation is a book review presented at each meeting by a member. On Nov. 9, Harvey Saldin reviewed the book entitled, "Zero to Eight."

NORTH DAKOTA STATE BRANCH showed the film "Heat and Its Control" at the meeting on Nov. 18.

NORTHEASTERN BRANCH members visited the ultra-modern windowless plant of the Simonds Saw and Steel Company in Fitchburg, Mass., on Nov. 5.

175 at Penn State Navy Day Meeting

On the evening of Oct. 27, approximately 175 members and guests of PENN STATE BRANCH attended a meeting in celebration of Navy Day. Speakers included the following U. S. Navy reserve officers: A. H. Zerban, N. R. Sparks, E. R. Queer, P. H. Schweitzer, J. S. Leister, and J. H. Jebens.

PRATT BRANCH members learned all about art and design from Mr. Dohner of the school's commercial art department. George E. Woodger, the corresponding secretary, says in his report, "The talk by Mr. Dohner was very interesting and held the whole group's attention, which is saying a great deal for any speaker."

PURDUE BRANCH at its last few meetings is stressing the importance of student members taking part in the 1939 Charles T. Main Award contest. Consequently, at the meeting of Nov. 10, Professors W. C. Beese, W. J. Cope, D. S. Clark, and J. H. Bowman introduced and discussed the subject of economics of investment in new manufacturing equipment in order to acquaint student members with this phase of the contest.

RICE BRANCH members recently visited the mill of the Champion Paper and Fiber Co. located below Houston on the ship canal. Raw material in the form of wood is supplied from the near-by pine woods, and power in the form of steam is piped over a mile distant from the plant of the Houston Light and Power Co.

SANTA CLARA BRANCH on Nov. 3 listened to a talk by M. Dieudonne on "Technological Unemployment."

U.S.C. BRANCH at its meeting of Nov. 16 heard a talk on the "Economic Comparison of the Alternative of Gas and Electric in Domestic Service." Sorry, but our correspondent forgot to tell us the name of the speaker.

Development of Engineers at Texas Branch

On Nov. 21, Prof. R. W. Warner, new head of the department of electrical engineering, spoke before the TEXAS BRANCH on "A Modern Plan for the Development of Engineers." His talk was concerned chiefly with the work of the E.C.P.D. and the S.P.E.E. in trying to broaden the cultural as well as the scientific side of the engineering profession.

TEXAS TECH BRANCH members made an inspection trip on Nov. 23 to the Lubbock cotton-seed-oil mill and the Lubbock cotton compress plant.

TORONTO BRANCH had Donald Carlisle of the Goodyear Tire & Rubber Company as the speaker for the meeting of Nov. 3. He spoke on "Tire Design," with particular reference to factors involved in designing tires for bus, truck, automobile, agricultural, and special uses.

Something New at Utah

Bruce Wiesley, secretary of UTAH BRANCH, reports that to further the reading of MECHANICAL ENGINEERING, two student members would be delegated for each meeting to report on various articles or some subjects related to the articles. A prize will be selected in the near future to be presented to the member giving the best review.

VERMONT BRANCH members were given a demonstration on the construction and operation of the U.S. Army machine gun, automatic pistol, trench mortar, and 37-mm gun at a special meeting on Nov. 18 by members of the R.O.T.C.

WASHINGTON BRANCH at its meeting of Nov. 17 showed the film on "Steam" to 42 members and 158 guests, a total of 200.

WEST VIRGINIA BRANCH has four or more members present papers at each meeting. At the meeting on Oct. 31, the speakers were K. E. Pyle, P. L. Atwell, H. Eisenhardt, and J. J. Teti.

125 at Wisconsin Meeting

The first meeting of the WISCONSIN BRANCH saw an attendance of 125 students. The next meeting in November featured the presentation of an illustrated lecture on "Lub Oils," by Mr. Rugg of the Pennsylvania Crude Oil Association.

YALE BRANCH members were guests of the Pennsylvania Railroad on Nov. 15 when they paid a visit to New York City. After viewing the many activities at the Penn Station, the boys went on a tugboat tour of New York Harbor.

W. L. Batt Speaks at A.S.A. Annual Meeting

New Officers Elected at Meeting on Nov. 30

W. L. BATT, past-president of the A.S.M.E., was guest speaker at the annual meeting of the American Standards Association held Nov. 30 at the Hotel Astor in New York. This meeting marked the twentieth year of the A.S.A. as national clearing house for the standardization work of American industry, including health and safety codes. Therefore, Mr. Batt's talk on the relationship between management and standardization was more than appropriate for the occasion.

Reporting briefly, F. M. Farmer, member A.S.M.E., and chairman of the Standards Council of the Association, announced that during the year, 21 new standards and 24 revisions of existing standards were approved. Eight new projects were started.

The following new officers of the Association were elected at the meeting: President, Edmund A. Prentis; vice-president, R. E. Zimmerman; chairman of Standards Council, F. M. Farmer; and vice-chairman of Council, R. P. Anderson.

Four Books on International Management Now Available

A LIMITED number of pamphlets on international scientific management are available from the Secretary's Office for the asking. They are "The Development of Scientific Management in Great Britain," "Present Developments in International Management Terminology," "Historical Survey of Contributions of International Labour Organization to the Study of Management," and "Die Entwicklung der Rationalisierung in Deutschland bis sum Jahre 1935."

I.A.S. Presents Second Wright Brothers Lecture

HUGH L. DRYDEN, member A.S.M.E., and chief of mechanics and sound division, National Bureau of Standards, presented the second Wright Brothers Lecture at a meeting held at Columbia University on Dec. 17, under the auspices of the Institute of the Aeronautical Sciences. The title of the lecture was "Turbulence and the Boundary Layer."

On Friday, Jan. 27, A. H. R. Fedden, president of the Royal Aeronautical Society, will be presented with the Daniel Guggenheim Medal at the honors night meeting and collation of the Institute in New York City.

W.P.A. Publishes Summary and Index of Research

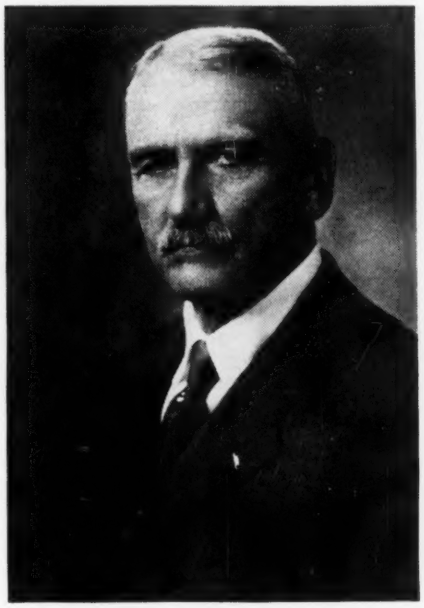
RESULTS of some 2000 research projects carried on as part of the federal work-relief program are summarized briefly in a digest and index which has been published by the Works Progress Administration. This volume of 291 pages contains a concise statement of the principal conclusions of each study and an alphabetical subject index to the contents. A limited supply of copies of this Index of Research Projects is still available. Requests should be addressed to the Works Progress Administration in Washington, D. C.

List of A.S.M.E. Aeronautic Papers Available

A LIST of more than 200 papers pertaining to aeronautics and associated subjects appearing in MECHANICAL ENGINEERING and A.S.M.E. Transactions for 1937 and 1938 is available to members for the asking. Write to A.S.M.E. Headquarters.

DEMONSTRATION JOB-INTERVIEW SESSION

(Prof. John R. Bangs, left, was chairman at the demonstration job-interview session on December 8. Maynard Boring, General Electric Co., Walter Bishop, center, Wright Aeronautical Corporation, and Paul W. Boynton, Socony-Vacuum Co., interviewed Howard E. Grantz, Brooklyn Polytechnic Institute, P. K. Langford, right, Stevens Institute of Technology, and David McCullough, Columbia University. *P.S.* Grantz and McCullough actually got jobs as a result of their interviews.)



JOHN FRANK STEVENS

John Frank Stevens to Be Given Hoover Medal

JOHN FRANK STEVENS, eighty-five year old civil engineer of Baltimore, Md., has been selected as the third recipient of the Hoover Medal, according to an announcement made recently by Gano Dunn, member A.S.M.E., and chairman of the Hoover Medal Board of Award. The Medal will be presented to Mr. Stevens during the annual meeting of the American Society of Civil Engineers in New York City, Jan. 19–20, 1939, with the following citation:

"JOHN FRANK STEVENS, engineer of great achievement as illustrated in his work on the Panama Canal, who, in his dealings with the Inter-Allied Forces in Siberia in the Great War, demonstrated those broader capacities for humanitarian public service beyond his calling, which have earned for him the recognition of the Hoover Medal for 1938."

In 1917 Mr. Stevens went to Siberia as chairman of the Commission of Railway experts to assist the Russian Provisional Government in the reorganization and operation of its badly organized railways. After the Armistice, he and a band of American railway men operated the crippled railroads and kept open "the back door to Russia." As a result, the Allied troops in Siberia were withdrawn successfully, supplies and foodstuffs provided, and the lives of thousands of natives saved.

The Hoover Medal was formally instituted on April 8, 1930, during the celebration of the fiftieth anniversary of The American Society of Mechanical Engineers, to commemorate the civic and humanitarian achievements of Herbert Hoover and to whom the first award was made. The second award was made to Ambrose Swasey in 1936. Conrad N. Lauer, Fellow A.S.M.E. and president of the Philadelphia Gas Works, created the award in 1929 with the gift of a trust fund which is held by the A.S.M.E. and administered by the Hoover Medal Board of Award.

United Engineering Trustees, Inc., Presents Annual Report for 1937–1938

Includes Facts Concerning Building, Finances, Library, and The Engineering Foundation

LOOKING BACKWARD at the twelve months ended Sept. 30, 1938, the President's Report of the United Engineering Trustees, Inc., presents an optimistic picture of continued stability of its financial portfolio as a whole, practically full occupancy of the Engineering Societies Building, gratifying use of meeting halls, and greater protection of the building.

The Engineering Societies Building in which are located the offices of the four Founder Societies and the Engineering Societies Library, has stood for thirty years as headquarters of the engineering profession. The physical condition of the building has been maintained and during the year extensive deferred mechanical maintenance has been met. All space in the building is occupied by the four Founder Societies and Associates on a cooperative basis, except for the area used in the activities of U.E.T. and its departments, and that used by the National Research Council's Division of Engineering and Industrial Research. Gratuitous use of meeting rooms has been granted to federal, state, and municipal organizations for military and WPA projects and, in cooperation with WPA and the Board of Education of the City of New York, for adult education classes in mathematics, languages, and other popular subjects.

Finances

It is heartening, and a distinct credit to the members of the Finance Committee who have given their time and effort so enthusiastically to this important work of the Trustees, to read in the financial counsel's summarized report that "despite the perplexing conditions surrounding the investment of funds during recent years, the portfolio continues to be in a strong position as to intrinsic security of principal and probable maintenance of income at a reasonable rate." With the usefulness of the Library and The Engineering Foundation dependent solely upon income from investment of gifts and bequests, it is fair to assume that under present conditions the work of the Trustees will continue to advance.

During the year, Ambrose Swasey's fifth gift was written onto the books at $86,977.16, bringing his gifts to a total book value of $818,632.91. The depreciation and renewal fund, which received during the year $20,000 and interest from investments amounting to $15,062.85, totaled on Sept. 30, 1938, $384,055.44 against a 32-year-old building carried at $1,453,793.92, which, with a property cost of $540,000, makes a total investment of $1,993,793.92. The capital investment in land and building is $6000 larger this year owing to the addition of library shelving for the use of the Engineering Societies Library, and paid for by assessment against the four Founder Societies.

The corporation is treasurer for the Engineers' Council for Professional Development and custodian of the John Fritz Medal Fund and Engineering Societies Employment Service Relief Fund.

Engineering Societies Library

The steadily growing calls upon the Library from abroad indicate the widening reputation that it is obtaining. They also indicate the general lack of libraries equipped to deal with highly technical questions, and the large opportunity that exists for a library with adequate funds for personnel and books. Until a larger staff with better engineering equipment can be provided and more adequate quarters made available, Harrison W. Craver, director, says that the Library will not be able to meet all calls as well as wished.

The number of readers was 31,376, an increase of 4626 over last year. In addition the Library aided 121 members by the loan of 141 books, 78 by making searches and copies, 113 by making translations, 2590 by making 20,689 photostats, 2974 by letter, and 4698 by telephone. By these various ways, the Library was used by 41,950 persons, 4973 more than in the previous year. Aid has been sought to establish the validity of patents, to assist in the preparation of theses and books, and to provide data for the design of machines and buildings.

Much work has been done in the Library by workers from various WPA projects in preparing bibliographies on soil conservation, aeronautics, and other subjects.

Additions during the year were 3091 volumes, 118 maps, and 29 bibliographies, making the collection at the end of year, 144,262 volumes, 7408 maps, and 4391 manuscript bibliographies. The lending collection contained 703 volumes and the number of duplicates is approximately 12,000 volumes. Through the generosity of W. S. Barstow, an expert binder continued to be employed during the year in repairing and rebuilding valuable old books.

The periodical index now contains over 225,000 references to important engineering articles, classified by the Universal decimal system, of which 21,000 were added during the current year. As this index grows it becomes increasingly useful to readers and staff, who find it convenient in many ways.

During the year 4146 volumes, 9748 pamphlets, 118 maps, and 29 bibliographies were acquired by purchase or gift, a total of 14,041 items, of which 12,242 items were gifts.

A special appropriation to the Trustees by the Founder Societies made possible the erection of special shelving, which relieved overcrowding and will, it is hoped, care for all needs for four or five years.

The Engineering Foundation

In 1914, The Engineering Foundation was founded for "the furtherance of research in science and engineering, and the advancement in any other manner of the profession of engineering and the good of mankind." In order to carry out the purposes of the Foundation, a total of 72 projects dealing with engineering and technical research, and the broader nontechnical matters of concern to the engineering profession had been or were being assisted by

(*Continued on page 100*)

A.S.M.E. Calendar

of Coming Meetings

February 23–25, 1939
Spring Meeting
New Orleans, La.

June, 1939
Oil and Gas Power Division Meeting
Ann Arbor, Mich.

July 10–14, 1939
Semi-Annual Meeting
San Francisco, Calif.

September 4–8, 1939
Fall Meeting
New York, N. Y.

October, 1939
Wood Industries Division Meeting
Boston, Mass.

SUMMARIZED BALANCE SHEET, SEPT. 30, 1938

Land, building, and equipment		$1,993,793.92
Funds:		
Engineering Foundation	$ 774,935.48	
Edward Dean Adams	90,872.61	
Library endowment	167,450.08	
Depreciation and renewal	384,055.44	
General reserve	10,189.62	1,427,503.23
Fifth Swasey gift		86,977.16
Henry R. Towne Engineering Fund		50,349.36
Cash		24,770.37
Accounts receivable		1,558.95
The Engineering Foundation (unexpended)		29,873.42
Alloys of Iron Research (unexpended)		5,594.75
Welding Research (unexpended)		1,215.32
The Engineering Foundation Custodian Fund		3,051.23
Total Assets		$3,624,687.71

money grants up to the end of the Foundation's current fiscal year. A few of these projects of interest and value to the A.S.M.E. include critical-pressure steam boilers, cottonseed processing, plasticity of metals, bearing metals, fluid flow, gears, screws, springs, riveted joints, engineering education and aptitudes, summer school for engineering teachers, E.C.P.D., and personnel research.

The available income during the year was only about $39,000. The relatively small grants possible from this modest income act as catalysts which stimulate the contribution of money, materials, and services by institutions, industry, and individuals, in many cases several times the amounts appropriated by the Foundation.

Local Sections

Coming Meetings

Anthracite-Lehigh Valley Section: January 27, Scranton Chamber of Commerce, Scranton, Pa., at 6:30 p.m. "Designing Welded Pipe System," by A. N. Kugler, Air Reduction Sales Company, N. Y. C.

Boston: January 5. Boston, Mass., evening meeting. Subject: "Modern Steam Generators," by Prof. A. G. Christie, President of the A.S.M.E., and professor of mechanical engineering, Johns Hopkins University, Baltimore, Md.

Erie: January 10. Pennsylvania Telephone Corp. Auditorium at 8:00 p.m. Subject: "Color Photography," by Francis T. Nagorski of Erie, Pa. Film dealing with phenomenon of light and how it is harnessed to serve man by means of optical instruments.

Greenville: January 11. Clemson College at 7:00 p.m. Dinner, to be held in Clemson Dining Hall previous to the meeting. An inspection of the dining halls, cold-storage rooms, and kitchens will be made before the dinner. Subject: "The Mechanics of Sanforizing," by Girrin Cluett, Cluett, Peabody & Co. Inc., Troy, N. Y. Two papers will be presented by student members of the Clemson A.S.M.E. Student Branch. Speakers to be selected on competitive papers in December.

Knoxville: January 3. University of Tennessee Cafeteria at 6:30 p.m. Subjects: "History of Pumping Engines," by Prof. Roscoe Morton, University of Tennessee, Knoxville, Tenn.; "Experiences Inspecting Government Equipment," by F. W. Groh, Tennessee Valley Authority.

Louisville: January 13. Lecture Room of the Speed Scientific School, University of Louisville. Subject: "Export Engineering," by John H. Romann, consulting engineer, Louisville, Ky.

North Texas: January 9. Dinner Meeting (place to be announced later) at 7:00 p.m. Subject: "Theories and Methods of Quick Freezing of Fruits, Vegetables, and Meats," by W. R. Woolrich, Dean of the School of Engineering, University of Texas, Austin, Texas.

Philadelphia: January 24. Engineers Club, Philadelphia, Pa., at 7:30 p.m. Subjects: "Centrifugal Pumps for High Temperature, High Pressure," by W. H. Waterman, engineer of the Byron Jackson Company, New York City, "Gas Expanders and Gas Compressors," by Paul Clarke, president of the Clark Brothers Co., Olean, N. Y.

January 12. Engineers Club, Philadelphia, Pa., at 7:30 p.m. Junior Section Meeting. Subject: "The Mechanical Engineer in the Oil Industry."

Providence: January 3. Providence Engineering Building, Providence, R. I., at 8:00 p.m. Subject: "Modern Steam Generators," by Prof. A. G. Christie, President of the A.S.M.E., and professor of mechanical engineering at Johns Hopkins University, Baltimore, Md.

San Francisco: January 26. Engineers Club, 206 Sansome St., San Francisco, Calif. Dinner at 6:00 p.m.; meeting at 7:30 p.m. Subject: "National Defense—Modern Developments in Aircraft, by Allan E. Bonallie, Oakland Air Port, Director of Instruction, Boeing Air School, Lieut.-Commander, U.S.N.R.

Waterbury: February 15, Joint Session of the Hartford, New Britain, and Waterbury Sections of the A.S.M.E. Dinner meeting at 6:45 p.m. at the Elton Hotel, Waterbury, Conn. Subject: "The Manufacture and Applications of Aluminum," by P. V. Faragher, Aluminum Company of America. Sound Films "From Mine to Metal" and "The Fabrication of Aluminum" will be shown.

Worcester: January 19. Dinner at 6:45 p.m. Meeting at 7:45 p.m. at the Sanford Riley Hall, Worcester Polytechnic Institute. Subject: "Analysis of Business and Economic Trends," by Allen W. Rucker, President, Eddy-Rucker-Nickels Company.

Men and Positions Available

Engineering Societies Employment Service

MEN AVAILABLE[1]

MECHANICAL ENGINEER, 20 years' experience combining design, manufacture, tooling, turbines, compressors, fans, pumps, heat exchangers, air-conditioning equipment. Prefers small city, to develop position rather than high salary. Me-206.

MECHANICAL ENGINEER, 28, single, graduate Polytechnic Institute of Brooklyn. Specialized student experience: punch, press, and boiler design; thesis, engine temperature-regulator development. Position preferred New York City or vicinity. Me-207.

INDUSTRIAL ENGINEER, graduate, age 29. Experience in development and application of wage incentives, time and motion study, cost and production control, and labor relations. Interested primarily in supervisory or executive position. South preferred. Me-208.

MECHANICAL ENGINEER, 40. Five years' machine development and design; 10 years' chemical-plant layout, equipment development, design, piping, plant construction; 3 years' sales engineer chemical plant and industrial equipment. Me-209.

MECHANICAL ENGINEER, age 31. Graduate 1928. Experience: Oil-refinery instrumentation application, power-plant operation and testing, automotive testing, textile-plant maintenance, machine design, drafting, and machine-tool operation. Me-210.

MECHANICAL ENGINEER, inventive mind, good theoretical and practical shop training, experienced in design and developing textile machines, automatic packaging machines, and special machine tools, desires responsible designing position. Me-211.

MECHANICAL ENGINEER, 26, single. Graduated University of Michigan, 1938. Major, power-plant design. Experience, draftsman, assistant constructional engineer, materials testing laboratory chemist. Desires power-plant or maintenance engineering. Prefers Eastern U. S. Me-212.

MECHANICAL ENGINEER, 26. Extensive experience in power-plant design and construction, including estimating costs and supervision of heavy oil-fired systems. Intimate knowledge of combustion, including burner design for heavy oil. Me-213.

MECHANICAL ENGINEER, 1938 graduate, A-1 college record. Thesis in automobile-engine design; desires to enter field of automotive, aircraft, or allied industries. Will go anywhere, start at bottom. Me-214.

MECHANICAL ENGINEER, 22, single, recent graduate. Desires position with engineering future. Willing to start at bottom. Well-trained in mathematics and design. Eastern U. S. preferred. Me-215.

MECHANICAL ENGINEER, 25 years' engineering and purchasing experience; 17 years' chief engineer, design, construction, and maintaining in economic operation roofing plants, coal-tar distillation units, and power plants. Will go anywhere. Me-216.

MECHANICAL ENGINEER, $6^1/_2$ years power-station design and construction; 7 years' management positions shipyard and heavy machinery; 5 years' operating experience steam and Diesel, New York professional and marine-operating licenses. Me-217.

INDUSTRIAL EXECUTIVE. Responsible, experienced, and successful industrial executive, now heading chain of diversified plants for nationally known concern, desires to centralize his activities in one location. Best of references, broadest capabilities. Me-218.

DEVELOPMENT EXECUTIVE ENGINEER with resourcefulness and initiative, seeks position supervising design of machinery, products, and plant processes of manufacture. Creative inventive ability, patent-law knowledge. Me-219.

POSITIONS AVAILABLE

GRADUATE MECHANICAL ENGINEER, 35–50, to act as chief engineer for a lime, cement, and mineral-wool company. Man who is well-

(Continued on page 102)

[1] All men listed hold some form of A.S.M.E. membership.

versed in Portland-cement mill design will be considered. Apply by letter. Location, South. Y-3496.

ASSOCIATE PROFESSOR, graduate mechanical engineer, 35–45, preferably with master's degree, to teach mechanical engineering in eastern university. Should have some practical experience in addition to at least 5 years' teaching experience. Must be of Catholic faith. Apply by letter. Y-3498.

ENGINEER to make survey of air conditioning, ventilation, and refrigeration in buildings owned by chain of restaurants. Must have experience in hotels or restaurants, and understanding of steam kettles, boilers, temperature control, ovens, etc. Must be free to travel. Salary, $3600–$5000 a year, plus $100 a month for expenses. Apply by letter. Headquarters, Middle West. Y-3507C.

MECHANICAL ENGINEER, 25–30, for development and design in laboratory. Company prefers man with knowledge of combustion and some experience in gas welding. Apply by letter. Location, New York, N. Y. Y-3513.

ENGINEER to write for a publication. Must have knowledge of all types of power-plant and manufacturing-plant equipment. Salary, $50 a week. Location, New York, N. Y. Y-3538.

MECHANICAL DRAFTSMAN with experience in planning of heating and ventilating equipment and air-conditioning systems. About six-months' work. Apply by letter. Location, South. Y-3539.

PRODUCTION ENGINEER, graduate mechanical engineer, 25–32, preferably single. Must be factory-minded. Traveling. Apply by letter. Headquarters, New York, N. Y. Y-3560.

GRADUATE MECHANICAL ENGINEER with experience in design of agricultural implements such as roughage mills, hay choppers, feed grinders, silo fillers, etc. Salary, $3500–$5200 a year. Apply by letter. Location, Middle West. Y-3574-R-648C.

SUPERINTENDENT to supervise the mass production and assembly of small interchangeable parts. Must have mechanical and production-control experience. Apply by letter. Location, New Jersey. Y-3584.

MECHANICAL SUPERINTENDENT with building maintenance experience. Apply by letter. Location, New York, N. Y. Y-3588.

MECHANICAL ENGINEER to act as assistant to sales manager. Must have experience in stamping field, and be familiar with estimating and pricing. Experience in selling cold-rolled strip in New England very desirable. Should have good personality, and be able to handle correspondence and other matters pertaining to sales in absence of sales manager. Apply by letter. Location, New England. Y-3607.

GRADUATE MECHANICAL ENGINEER, 35–45, with at least five years' experience as works manager of metal-working plant having as part of its processes metal stamping, deep drawing, and polishing. Experience in nonferrous foundry work also desirable. Applicant must show successful record of accomplishment as works manager of company now in good standing. Apply by letter. Location, New England. Y-3608.

Candidates for Membership and Transfer in the A.S.M.E.

THE application of each of the candidates listed below is to be voted on after January 25, 1939, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references.

Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Reelection; Rt = Reinstatement; Rt & T = Reinstatement and transfer to Member

NEW APPLICATIONS

For Member, Associate, or Junior

ANDERSON, JOHN A., New York, N. Y.
BAILEY, EUGENE C., La Grange, Ill.
BARKSDALE, L. S., El Segundo, Calif.
BANTON, MADISON W., Summit, N. J.
BARRIE, JOHN GREGG, New York, N. Y.
BEAN, JAS., Los Angeles, Calif.
BELLINGER, C. A., Forest Hills, L. I.
BUERGER, HERBERT M., Prince Bay, S. I., N. Y.
BURDICK, WM. E., Eddystone, Pa.
CARR, LOUIS B., Wilmington, Del.
DENISTON, R. F., Chicago, Ill.
FIDALGO, MANUEL H., Ponce, Puerto Rico
FOLMSBEE, C. H., Berwick, Pa.
GROMADA, ADOLF, McKees Rocks, Pa.
GUERDAN, G. A., Weehawken, N. J. (Rt & T)
HANNA, JOHN H., JR., Washington, D. C.
HIGGINS, W. ALLAN, Toronto, Ont., Canada
HOLLAND, CYRUS J., Chicago, Ill.
HUSTON, F. P., Fanwood, N. J.
JOHNSON, J. MARSHALL, Chattanooga, Tenn.
KOESTER, WILBUR F., Detroit, Mich.
LEFEVER, PAUL M., Conowingo, Md.
MARMOREK, ERNEST, New York, N. Y.
MASON, H. L., Portland, Oregon (Rt)
MICHETTI, ALBERT L., Philadelphia, Pa.
MORAN, JOS. J., Somerville, Mass.
MUENZ, O. A., Newark, N. J. (Rt)
MUIR, WM. P., Hampstead, Que., Canada
NOURSE, CHESTER L., Boston, Mass. (Rt)
PETTY, PAUL B , New York, N. Y.
POSSE, E. W., Bloomfield, N. J.
RIDLEY, KENNETH J., Amsterdam, N. Y.
ROMBACH, J. ROBT., JR., New Orleans, La.
SCHAFLER, N. I., Cedarhurst, L. I., N. Y.
SCHRADER, HERMAN J., Urbana, Ill.
STEINBERG, MAX J., New York, N. Y.
TYLASKA, T. T., Houston, Tex.
WEBBER, W. W., New Haven, Conn. (Rt & T)
WESTERGAARD, H. M., Cambridge, Mass.
WITTIG, CARL O. G., Golden, Colo.
WORTHINGTON, J. G., Indianapolis, Ind.

CHANGE OF GRADING

Transfer from Junior

BOWMAN, ROBT. A., Philadelphia, Pa.
BEATTY, CHAS. E., Leadville, Colo.
HANSON, KARL P., Baltimore, Md.
HEINZ, W. B., Bound Brook, N. J.
HEQUEMBOURG, J. E., West Caldwell, N. J.
HILL, WM. P., Dundalk, Md.
MORSE, LOUIS S., JR., Detroit, Mich.
SINGH, JAGIR, Attock, India

Necrology

THE deaths of the following members have recently been reported to the office of the Society:

ABELL, HARRY C., November 24, 1938
ABORN, GEORGE P., July 7, 1938
BAKER, HUGH J., August 12, 1938
BLAKE, EDMUND E., June 21, 1938
DOTY, PAUL, December 3, 1938
FARLEY, ERNST W., October 14, 1938
HARRIS, CHARLES H., October 22, 1938
HAWN, RUSSELL J., October 14, 1938
IVENS, EDMUND M., September 13, 1938
JENKS, WILLIAM H., March 13, 1938
LAWTON, M. A., October 21, 1938
LEWIS, HERSCHEL P., October 1, 1938
MCKIEVER, WILLIAM H., August 3, 1938
MCQUEENEY, JAMES T., October 9, 1938
WEBER, O. L. E., May 30, 1938

A.S.M.E. Transactions for December, 1938

THE December, 1938, issue of the Transactions of the A.S.M.E., which is the *Journal of Applied Mechanics*, contains the following papers:

TECHNICAL PAPERS

The Effect of the Speed of Stretching and the Rate of Loading on the Yielding of Mild Steel, by E. A. Davis

Simultaneous Effects of Corrosion and Abrupt Changes in Section on the Fatigue Strength of Steel, by T. J. Dolan

The Fundamentals of Three-Dimensional Photoelasticity, by M. Hetényi

The Calculation of Steam-Turbine Reheat Factors, by R. B. Smith

Reheat Factors for Expansions of Superheated and Wet Steam, by C. G. Thatcher

Steady Oscillations of Systems With Nonlinear and Unsymmetrical Elasticity, by Manfred Rauscher

DISCUSSION

On previously published papers by E. H. Hull; B. F. Langer; and E. A. Davis

BOOK REVIEWS

By S. Timoshenko and F. Bitter